MONTHLY WEATHER REVIEW.

Editor: Prof. Cleveland Abbe.

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INTRODUCTION.

The Monthly Weather Review for December, 1898, is based on about 2,762 reports from stations occupied by regular and voluntary observers, classified as follows: 162 from Weather Bureau stations; numerous special river stations; 32 from post surgeons, received through the Surgeon General, United States Army; 2,385 from voluntary observers; 96 received through the Southern Pacific Railway Company; 29 from Life-Saving stations, received through the Superintendent United States Life-Saving Service; 31 from Canadian stations; 10 from Mexican stations; 7 from Jamaica, W. I. International simultaneous observations are received from a few stations and used, together with trustworthy newspaper extracts and special reports.

Special acknowledgment is made of the hearty cooperation of Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada; Mr. Curtis J. Lyons, Meteorologist to the Hawaiian Government Survey, Honolulu; Dr. Mariano Bárcena, Director of the Central Meteorological and Magnetic Observatory of Mexico; Mr. Maxwell Hall, Government Meteorologist, Kingston, Jamaica; Capt. S. I. Kimball, Superintendent of the United States Life-Saving Service; and Commander J. E. Craig, Hydrographer, United States Navy.

The Review is prepared under the general editorial supervision of Prof. Cleveland Abbe.

Attention is called to the fact that the clocks and self-registers at regular Weather Bureau stations are all set to seventy-fifth meridian or eastern standard time, which is exactly five hours behind Greenwich time; as far as practicable, only this standard of time is used in the text of the Review, since all Weather Bureau observations are required to be taken and recorded by it. The standards used by the public in the United States and Canada and by the voluntary observers are believed to generally conform to the modern international system of standard meridians, one hour apart, beginning with Greenwich. Records of miscellaneous phenomena that are reported occasionally in other standards of time by voluntary observers or newspaper correspondents are sometimes corrected to agree with the eastern standard; otherwise, the local meridian is mentioned.

FORECASTS AND WARNINGS.

By Prof. E. B. Garriott, in charge of Forecast Division.

But one storm of marked strength visited the Great Lakes and the Atlantic seaboard in December, 1898. This storm appeared over the west part of the Gulf of Mexico on the 2d and moved thence to the St. Lawrence Valley by the 5th, with wind velocities of 30 to 40 miles an hour along the middle and west coasts of the Gulf of Mexico on the 3d, and velocities of 40 to 60 miles an hour over the lower Lakes and along the middle Atlantic coast on the 4th. The highest wind velocity on record at the Weather Bureau office at New York city, 76 miles an hour from the east, was registered during the night of the 4th. During the 5th hard westerly gales continued along the middle Atlantic and New England coasts. Throughout its course the storm was attended by heavy precipitation, and in the lower Lake region and parts of New York and New England heavy snow, drifted by high winds, seriously interfered with traffic and telegraphic communication.

Action in distributing warnings in advance of the disturbance was taken by the Weather Bureau as follows: The morning of the 3d storm signals were ordered for the middle and west coasts of the Gulf of Mexico, and shipping interests in those sections were advised that a storm was central over Louisiana moving northeast, and were warned of high northwest winds and much colder weather. Especially dangerous features were not, however, developed during the 3d, but as an increase in intensity almost invariably attends the northward advance of storms of this class, close watch was kept upon its movements by means of special reports, and storm signals, based upon noon reports, were ordered on the Atlantic coast from Hatteras to Eastport. In the evening storm signals were ordered for the lower Lakes and the south Atlantic coast.

The morning of the 4th, when the storm was central over Kentucky, hurricane signals were ordered along the Atlantic coast from Cape May to Eastport by the following message:

> Hoist hurricane signals at once. Northeast hurricane winds with heavy snow in New York and New England.

Hurricane signals were also ordered at all ports on Lakes Ontario and Erie, and at Detroit, Mich., with the information that heavy rain would turn to snow, and observers and displaymen were directed to hold all shipping in port.

These extreme warnings called for the greatest possible activity on the part of all employees of the Weather Bureau in the sections for which the signals and warnings were issued, and notice of the approaching storm and of its exceptional severity was given a most effective distribution among the maritime, commercial, and traffic interests, and, so far as possible, shipping was held in port.

Information contained in reports of observers and the daily press shows that a northeast gale of terrific force began over the lower Lakes the afternoon of the 4th. At Detroit high wind and heavy snow disabled the street car service. Managers of lines received ample warning but the snow was too heavy to be handled with the facilities at hand. All vessels in, and passing, that port were warned. Late in the afternoon telegraphic communication was cut off. At Cleveland the storm was reported the most severe of the season. The warning was heeded, and vessels and their cargoes, valued at upward of $800,000 were sheltered in that port. The observer states that a disregard of the warnings would have resulted in a loss of vessels and lives. Throughout the interior of New York the high wind and heavy snow which began on the 4th continued during the 5th, 6th, and 7th, delaying railroad traffic. Considerable damage by high wind was caused along the New Jersey coast. Many captains heeded the storm signals hoisted on the 3d, and upward of 100 steamers and sailing vessels sought refuge at Sandy Hook and Gravesend Bay. At Long Branch, Sunday night, the wind reached a velocity of 70 miles an hour from the east, and heavy seas carried away 160 feet of the iron pier. The signals kept many vessels in port at New York and other harbors of the north Atlantic coast, and in view of the exceptional severity of the storm many casualties were doubtless averted by the general regard given to the warnings.

COLD WAVE WARNINGS.

The first well-marked cold wave of the month appeared over the upper Missouri valley on the 12th; extended over the States of the upper Mississippi valley and the western Lake region during the 13th, carrying the line of zero temperature to southern Iowa, and reached the Atlantic and Gulf coasts on the 14th, with a minimum temperature of 30° at New Orleans, 28° at Mobile, 30° at Savannah, and 38° at Jacksonville. The second wide-spread cold wave of the month extended over the northern Rocky Mountain region and the upper Mississippi valley the night of the 28th, and reached the Atlantic coast and Gulf States on the 31st, with zero temperature to the southern line of Kansas, and freezing weather almost to the west Gulf coast. All sections and interests, likely to be injuriously affected, received prompt and ample notification of the approach of these cold waves.

CHICAGO FORECAST DISTRICT.

The abnormally cold weather which prevailed during the last nine days of November in the district continued with almost remarkable persistence until the middle of December. In Chicago during the entire period of twenty-four days there was but one day on which the temperature was above normal. This condition seriously affected the shipments of perishable goods, and shippers in Chicago and at other points were in daily communication with the Chicago office by telephone and otherwise. Each morning during the winter the probable minimum temperature at Chicago for the ensuing night is forecast, and both shippers and transportation companies find this to be of great value in the movement and protection of perishable produce. With the breaking up of the western high pressure area on the 14th instant, shippers were advised that less caution was necessary, and the period of comparatively mild weather for more than a week was advantageously used by them.

A well-marked cold wave developed in the Canadian Northwest during the night of December 28, and spread eastward and southward over the entire district during the 29th and 30th. Ample warning of its approach was given for all sections except a portion of the Rocky Mountain region, where its advent was very sudden.

During the portion of the month in which storm signals were displayed, but one storm occurred on the lakes which seriously affected navigation, that of December 4 on Lake Huron. This storm first appeared as an unimportant disturbance over the western Gulf States on December 1, and remained nearly stationary for forty-eight hours. On the 3d it began to move northeastward, increasing very much in intensity. On the morning of the 4th it was central over the middle Ohio Valley, and in the evening its center was over Pennsylvania. Heavy snow and severe gales accompanied the disturbance. Storm signal orders and warning messages were sent to Lakes Michigan and Huron ports on the afternoon and evening of the 3d. Warnings of heavy snow were also sent to the southeastern portion of Lower Michigan on the morning of December 4.—*H. J. Cox, Forecast Official.*

SAN FRANCISCO FORECAST DISTRICT.

On the evening of December 8, it was evident that a severe northeast gale would prevail during that night and the following day in portions of California. An effort was made to reach the chief wharfinger at 6 p. m., and notify him to advise all shipping in the harbor to take unusual precautions. The office was closed and the official could not be found. The warning was given to the Merchants' Exchange, the principal maritime body in the city, with a request to distribute it as far as possible. However, some vessels either failed to get the warning or failed to take the necessary precautions to prevent injury. The northeast storm signal was displayed on the following morning at San Francisco and points to the northward, and the information signal on the coast south of San Francisco. Probably the most severe northeast gale in the history of the State occurred during the 9th of December. The wind attained a velocity of 96 miles an hour at Point Reyes, and 44 miles at San Francisco. A lumber raft which was tied to the wharf at the north end of the city, went to pieces during the gale. The damage to shipping in the harbor, and to wharves, amounted to upward of $2,000. It would probably have been considerably more had not some precautions been taken.

On December 10 warning of a severe frost, probably injurious to citrus fruit, was distributed throughout California, which was verified in almost all portions of the State except southern California. Precautions were taken to reduce the damage to a minimum, and in the northern portion, where the most severe temperatures occurred, a large portion of the crop was picked and injury thus prevented, while in the southern portion the temperatures were not so severe but what the methods of protection resorted to were ample to prevent injury. Temperatures from 26° to 34° prevailed throughout the entire State except the extreme southwestern portion.

On December 13 the weather map showed conditions favorable for a storm in California and warnings of rain were distributed in the northern portion of the State. Prior to this storm one of the most severe periods of drought ever known in the history of California had prevailed. With the exception of two months of very light rainfall there had been a continued deficiency of rainfall for over twenty months, and the present season had progressed until near its middle with but little rainfall. The supply of feed and hay for stock had become exhausted throughout the entire southern portion of the State and stock had commenced to die from starvation. One large owner had just made arrangements to ship eighteen carloads of cattle from Monterey County to Nevada, and most extreme measures were being resorted to to prevent stock

suffering. This warning of rain did much to allay the existing anxiety, and caused many stockmen to delay undertaking expensive methods to prevent loss. About one-half inch of rain occurred in the Sacramento Valley and central coast section. This was followed by another rain in northern California from the 19th to 21st.

On December 28 warnings of a severe norther were distributed throughout northern California and northwest storm signals ordered at points from San Francisco northward, and a warning of much colder weather, accompanied by snow, was distributed in Nevada and Utah. A maximum wind velocity of 32 miles an hour occurred at Eureka and 72 miles northwest at Point Reyes, and high north to northwest winds and gales prevailed throughout the State north of the Tehachapi during the night of the 28th and the 29th. Maximum velocities of wind of 36 miles per hour were reported from Carson City and Winnemucca and 60 miles at Independence. A current velocity of 20 miles from the northwest was reported from Salt Lake City. The gales in Nevada and Utah were accompaned by snow, the temperature falling to 4° and 6° above zero on the morning of the 30th in Nevada and Utah.

On the last day of the month the conditions indicated that a storm of unusual severity was approaching the Oregon coast; southeast storm signals were ordered at points along the California coast north of San Francisco. This storm verified the signals which it is believed were of considerable value.—*W. H. Hammon, Professor, Weather Bureau.*

FROST WARNINGS FOR TEXAS.

The morning map of December 3 showed conditions which might give injurious weather in the sugar and trucking region. A cold wave and "norther" was forecast for Texas by the Central Office at Washington, and the following warning was issued by the Galveston office of the Weather Bureau:

Probably freezing in sugar and trucking region Sunday (4th).

At 2:25 p. m. the following additional warning was distributed:

Temperature will fall to 34° and probably freezing at Galveston, and to 28° 50 to 100 miles from Galveston Sunday morning.

All sugar planters and truck growers to the coast line were advised by telegraph and long-distance telephone to protect their crops, and action was taken accordingly. The sugar cane in the north half of the sugar belt had been cut on advice given November 21. This left standing in the southern portion of the sugar belt about 40,000 tons of cane which it was desired to windrow in case of a freeze. This at the selling price in the field, $3 a ton, made the value $120,000. Besides this there were vegetables subject to loss by freeze which in the aggregate were worth more than $150,000. Sunday morning the temperature fell to 35° at Galveston, 34° at Houston, and to 30° at Brenham. The reports of Sunday morning indicated a further fall in temperature and additional warnings of frost were issued, and sugar planters were advised to prepare for freezing weather. Sunday night and Monday morning there was heavy frost on Galveston Island, and killing frost and temperature as low as 28° in the sugar and trucking regions, and had not the action advised been taken cane and vegetables to the value of many thousands of dollars would have been lost. Many acknowledgments of the value of the warnings have been made. Referring to these warnings the Galveston Daily News of December 6, 1898, remarks as follows:

A heavy white frost put in its appearance yesterday morning, just as predicted by the United States Weather Bureau. While heavy white frosts occur nearly every winter on the mainland, Galveston has an average of one winter in five without frost or freezing, and even with freezing weather heavy white frosts are uncommon on the island. Everybody looked for and made preparation for this frost, because the weather service had said it would occur. The warnings of injurious weather conditions made for this section have been so accurate of late years, and consequently of so great value to the public, that they have become a great factor with the sugar planters and truck growers who care for their extensive crops, as the Weather Bureau advises them. One feature which demonstrates their marked confidence in the warnings is that they take action to protect their crops as the warnings suggest. The different localities have systems in operation for the distribution of information. Some localities have distribution by telephone, others by mounted messenger service, and in others the planters distribute the information from one to his adjoining neighbor until all are advised.

There are few, if any, sections where the weather service can be of greater value than to this part of the country. The large sugar and truck farming interests use the warnings to such an extent that it saves them hundreds of thousands of dollars annually.

I. M. Cline, Local Forecast Official.

PORTLAND, OREG., FORECAST DISTRICT.

Signals were ordered up on the 10th, 18th, and 31st; they were verified in each instance. Numerous freighters, steamers, and sailing vessels heeded warnings and no casualties are reported.

There was no damage resulting from rain, frosts, or high winds. The river had no material rise.

The railroads made considerable use of the snow forecasts during the early part of the month. Fires were kept up in the rotary snow engines and they were moved to the mountain districts upon information issued from this office.

Two carloads of bananas were moved into Oregon and this city upon information issued, and were received and marketed in good condition.

On December 14 forecasts for snow were issued. Snowfall was general, except in and about Portland, where fair weather prevailed.—*B. S. Pague, Forecast Official.*

AREAS OF HIGH AND LOW PRESSURE.

During the month seven highs and nine lows were sufficiently well defined to be traced on Charts I and II. On these charts the circle is placed at the position of the high or low at 8 a. m. or 8 p. m. of each day, and inside this circle are placed the date, time, and barometer reading at the center. The accompanying table exhibits the principal facts relating to the origin, disappearance, duration, and velocity of these highs and lows, and the following special notes are added.

The month has been characterized by pressures largely above normal in the southwest and west, and these conditions have controlled the development and motion of the highs and lows. Oftentimes the rather permanent high area in the Plateau region has spread southeastward into Texas but without any motion.

Highs.—High No. II was the only one originating on the Pacific coast; III and IV were first seen in the north Plateau region, VII to the north of Montana, I in Kansas, and V and VI to the north of Lake Superior. The general motion was to the eastward or southeastward. Nos. II, III, IV, and VII were merged in a subpermanent high in the Gulf of Mexico or over Florida, and I, V, and VI were last noted in the Gulf of St. Lawrence. The temperature oscillations accompanying these highs were very moderate up to the last week of the month. On the morning of the 27th, as No. VII approached Minnesota, Winnipeg experienced a fall of 50° in twenty-four hours and to —18°, and Moorhead a fall of 38° and to 4°. On the evening of the 28th, as the same high approached the Atlantic coast, Northfield reported a fall of 41° and to 8°, and the next morning Eastport reported a fall of

38° and to 8°. The severest cold wave of the month occurred in front of No. I high in the January MONTHLY WEATHER REVIEW. A fall of 52° was reported at Rapid City evening of 29th, and minimum temperatures of —24° and —22° occurred at Duluth and Moorhead, respectively, a. m. of 31st.

Lows.—Six of the lows made their first appearance to the north of Montana; No. V was first noted off the south Pacific coast, No. VII in the south Rocky Mountain region, and No. II in the west Gulf. The general tendency of all the storms was eastward or north of east, and all but V and VII could be followed to Newfoundland. No. VII merged with VI over Lake Huron, and V was last noted off Cape Cod. The highest winds of the month were reported as follows: Evening of 4th, as storm No. II approached the middle Atlantic coast, Cape May reported an east wind of 67 miles an hour and New York City an east wind of 60 miles. On morning of 5th New York City reported an east wind of 76 miles and Block Island a southwest wind of 69 miles. On evening of 5th Eastport reported an east wind of 72 miles. On a. m. of 11th Buffalo reported a west wind of 60 miles while storm No. III was hovering near the Gulf of St. Lawrence.—*Prof. H. A. Hazen.*

Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocities.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long W.	Length.	Duration.	Daily.	Hourly.
High areas.		°	°		°	°	*Miles.*	*Days.*	*Miles.*	*Miles.*
I	*30, p. m.	39	96	4, a. m.	49	64	2,370	3.5	677	28.2
II	1, p. m.	39	125	6, p. m.	29	83	3,270	5.0	654	27.2
III	5, a. m.	47	120	11, p. m.	30	90	2,880	6.5	443	18.5
IV	11, p. m	45	112	18, p. m.	31	80	3,660	7.0	523	21.8
V	18, a. m.	50	86	21, a. m.	48	63	1,380	3.0	460	19.2
VI	24, a. m.	51	90	26, p. m.	46	59	1,530	2.5	612	25.5
VII	26, p. m.	54	107	29, p. m.	32	79	2,250	3.0	750	31.2
Total	......	......	......	......	......	......	17,340	30.5	4,119	171.6
Mean of 7 paths	......	......	......	......	......	......	2,477	......	588	24 5
Mean of 47.5 days	......	......	......	......	......	......	......	......	569	23.7
Low areas.										
I	*29, a. m.	49	124	2, p. m.	38	97	1,740	3.5	497	20.7
II	1, a. m.	27	94	6, p. m.	48	53	3,240	5.5	589	24.5
III	4, a. m.	52	114	8, p. m.	47	52	2,850	4.5	633	26.4
IV	16, a. m.	54	117	19, a. m.	49	53	2,830	3.0	940	39.2
V	16, a. m.	32	119	20, p. m.	41	69	3,210	4.5	713	29.7
VI	19, a. m.	53	118	24, a. m.	49	51	3,240	5.0	648	27.0
VII	20, p. m.	37	107	22, p. m.	46	84	1,590	2.0	795	33.1
VIII	24, p. m.	54	111	29, a. m.	47	54	2,700	4.5	600	25.0
IX	26, p. m.	55	120	31, a. m.	47	52	3,210	4.5	713	29.7
Total	......	......	......	......	......	......	24,600	37.0	6,128	255.3
Mean of 9 paths	......	......	......	......	......	......	2.733	......	681	28.4
Mean of 47.5 days	......	......	......	......	......	......	......	......	665	27.7

*November.

RIVERS AND FLOODS.

The crest of the rise which was moving down the lower Mississippi at the close of November reached New Orleans on the 2d of December with a maximum stage, however, of but 6.2 feet, which was the highest for the month. Above there was a general fall in the Mississippi and Ohio and their tributaries which continued in the Mississippi and Missouri until the 16th, when, owing to a moderate thaw, a rise began in the lower Missouri and middle Mississippi, the advance reaching St. Louis on the same day. A similar cause inaugurated a slow rise in the Ohio, commencing at Pittsburg on the 17th. Heavy rains on the 18th and 19th over the Mississippi and Ohio valleys accentuated matters, and a pronounced rise set in over both rivers. The rise in the Mississippi and Missouri was of limited extent, the crest reaching St. Louis on the 26th when the gauge read 9.8 feet, a rise of 9.3 feet in eleven days. The wave in the Ohio continued to increase at Pittsburg until the crest of 15.2 feet was reached on the 22d, a rise of 13 feet in five days, 7 feet of which occurred during the twenty-four hours ending at 8 a. m. of the 21st. The crest continued down the river, reaching Wheeling on the 23d, Parkersburg on the 24th, Cincinnati on the 27th, with a total rise at the latter place of 21.6 feet in nine days to 31.9 feet, Louisville on the 28th, Evansville on the 30th, and Cairo on January 1, 1899, the increase from the Mississippi also reaching there on the 27th and 28th. In the lower Mississippi the rise began at Memphis on the 22d, Vicksburg on the 26th, New Orleans on the 28th, and continued at the end of the month. The rises in the tributaries occurred as a rule between the 19th and 25th.

No flood stages occurred, and a slow fall was in progress at the close of the month north and east of Cairo, except at Pittsburg. The tributaries were also falling generally, except those of the extreme upper Ohio.

In the Atlantic and Southern States and on the Pacific coast matters regarding river stages were uneventful and nothing of importance was recorded.

With the progress of the winter season there was a rapid advance of the ice line to lower latitudes. During November the southernmost limit reached by floating ice was about the mouth of the Missouri River, and the lowest limits of total freezing were Omaha on the Missouri and Leclaire, Iowa, on the Mississippi. Conditions on the upper Missouri remained practically unchanged during the month, but south of Omaha there was a considerable increase in the amount of ice, although there were no gorges of consequence. The river closed for a short time on the 9th about 2 miles above Kansas City, and ice 9 or 10 inches thick was harvested on the same day. At Boonville, Mo., there was floating ice constantly after the 5th, and on the 15th there was a gorge extending from a short distance below Boonville to Hermann, Mo., the ice remaining solid at the latter place uutil the 18th. Navigation was suspended on the 8th, and had not been resumed at the close of the month, heavy floating ice still continuing. From Omaha northward there remained solid ice, varying from 10 inches in thickness at that city to 20 inches at Bismarck, and there were also 24 inches at Moorhead on the Red River.

On the Mississippi the ice became solid at Davenport on the 7th and at Keokuk on the night of the 8th, while the Des Moines River at Des Moines froze over on the 9th.

Floating ice was generally present north of the mouth of the Missouri River, and at Hannibal there was a gorge above the Wabash bridge which lasted from the 4th until the evening of the 28th. At St. Louis there was floating ice on the 5th and 12th, at Chester on the 6th and 13th, and a small quantity at Cairo on the 8th and 9th. At the close of the month the ice ranged in thickness from 14 inches at Keokuk to 22 inches at St. Paul.

The Illinois River at Beardstown, Ill., closed on the 8th.

The Ohio was full of slush ice at Pittsburg on the 7th and also on the 10th and 11th. On the 15th navigation was necessarily closed. On the 20th the thaw resulted in a quantity of slush ice in the Allegheny, which lasted until the 31st. At Parkersburg there was heavy ice in both rivers from the 10th to the 12th, and the Ohio was frozen over from the 13th to the 18th. Navigation was resumed on the 19th and continued, although the river was not free from ice until the 25th. At Portsmouth, Ohio, navigation was suspended from the 11th to the 20th on account of running ice. At Cincinnati running ice, beginning on the 9th, caused a temporary suspension of navigation on the 10th. On the 14th the river was full of ice, and navigation was again suspended, but the thaw of the 19th permitted its resumption, and on the 21st the river was practically free from ice. At Louisville navi-

gation was impeded on the 14th and suspended on the following day, but was resumed on the 18th. At Evansville there was floating ice on the 14th, and navigation was suspended on the 15th, some boats being moved to the winter harbor in Green River through fear of a gorge, but by the 18th there was little or no ice, and navigation was fully resumed. At Cairo there was some ice from the 14th to the 18th, but by the 23d there was none in either river, the southern ice limit for the month being practically established here.

The Susquehanna was frozen over at Wilkesbarre, Pa., from the 12th until the 23d. At Harrisburg there was slush ice on the 8th, which gradually increased in quantity until the 15th. It was also present in greater or less quantities after the 18th. In the West Branch there was slush ice at Williamsport, Pa., on the 8th, freezing solid on the 9th, and remaining so until 2 p. m. of the 23d, after which time running ice was constant, continuing at the close of the month.

There was a gorge in the Potomac on the 22d about 25 miles east of Cumberland, Md., which at one time threatened great destruction to dams and property close to the river, but it moved out without causing serious damage.

On the Pacific coast large quantities of floating ice in the Columbia River, commencing on the 12th, seriously impeded navigation, which was not resumed until the 19th, when the ice broke. There was no ice in the Willamette River.

The highest and lowest water, mean stage, and monthly range at 118 river stations are given in the accompanying table. Hydrographs for typical points on seven principal rivers are shown on the Chart. The stations selected for charting are: Keokuk, St. Louis, Cairo, Memphis, and Vicksburg, on the Mississippi; Cincinnati, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Forecast Official.*

Heights of rivers referred to zeros of gauges, December, 1898.

Stations.	Distance to mouth of river.	Danger line on gauge.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Mississippi River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
St. Paul, Minn	1,957	14	Frozen	....	....	....	.....	.....
Reads Landing, Minn	1,887	12	0.4	18, 20, 21, 24–27	—0.9	6,8	0.4	1.3
Red Wing, Minn	....	......	Frozen	....	....	....	.....	.....
La Crosse, Wis	1,822	12	Frozen	....	....	....	.....	.....
North McGregor, Iowa	1,762	18	2.7	26, 27	1.5	1	2.1	1.2
Dubuque, Iowa	1,702	15	Frozen	....	....	....	.....	.....
Leclaire, Iowa	1,612	10	Frozen	....	....	....	.....	.....
Davenport, Iowa	1,596	15	Frozen	....	....	....	.....	.....
Galland, Iowa	1,475	8	Frozen	....	....	....	.....	.....
Keokuk, Iowa	1,466	14	Frozen	....	....	....	.....	.....
Hannibal, Mo	1,405	17	2.7	25	— 0.6	6	1.2	3.3
Grafton, Ill	1,307	23	4.9	25, 26	1.9	9, 10	3.9	3.0
St. Louis, Mo	1,264	30	9.8	26	0.3	11	4.1	9.5
Chester, Ill	1,189	30	6.4	27, 28	—1.0	12	2.5	7.4
Cairo, Ill	1,073	45	23.2	31	10.4	19	14.2	12.8
Memphis, Tenn	843	33	14.6	31	5.8	21, 22	8.0	8.8
Helena, Ark	767	42	18.4	31	9.7	23	12.4	8.7
Arkansas City, Ark	635	42	19.5	31	11.2	23	14.0	8.3
Greenville, Miss	595	42	14.8	31	8.9	24	11.5	5.9
Vicksburg, Miss	474	45	16.5	1	9.4	24–26	12.3	7.1
New Orleans, La	108	16	6.2	2, 3	3.8	27, 28	4.8	2.4
Arkansas River.								
Wichita, Kans	720	10	2.8	20	1.3	17	1.8	1.5
Fort Smith, Ark	345	22	12.2	22	3.9	15–18	6.1	8.3
Dardanelle, Ark	250	21	11.9	24	2.6	17	5.5	9.3
Little Rock, Ark	170	23	13.2	25	3.6	15	6.8	9.6
White River.								
Newport, Ark	150	26	12.7	23	3.5	17, 18	6.8	9.2
Des Moines River.								
Des Moines, Iowa	150	19	Frozen	....	....	....	.....	.....
Illinois River.								
Peoria, Ill	135	14	8.4	1	5.9	20, 21	7.0	2.5
Missouri River.								
Bismarck, N. Dak	1,201	14	4.2	20, 21	2.8	1	3.5	1.4
Pierre, S. Dak	1,006	14	Frozen	....	....	....	.....	.....
Sioux City, Iowa	676	19	Frozen	....	....	....	.....	.....
Omaha, Nebr	561	18	Frozen	....	....	....	.....	.....
St. Joseph, Mo	373	10	— 0.7	31	— 3.1	4, 8	—1.7	2.4
Kansas City, Mo	280	21	8.1	24	4.0	12	6.1	4.1
Boonville, Mo	191	20	8.2	24	1.7	14	4.3	6.5
Hermann, Mo.‡	95	24	10.0	25	2.1	13	5.6	7.9

Heights of rivers above zeros of gauges—Continued.

Stations.	Distance to mouth of river.	Danger line on gauge.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Ohio River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Pittsburg, Pa	966	22	15.2	22, 24	2.2	12, 16, 17	5.9	13.0
Davis Island Dam, Pa	960	25	14.6	24	4.1	16	7.3	10.5
Wheeling, W. Va	875	36	22.8	23	4.9	15	9.9	17.9
Parkersburg, W. Va	785	36	23.5	24, 25	7.1	1, 2	9.9	16.4
Point Pleasant, W. Va	703	39	27.0	25, 26	3.9	17	12.1	23.1
Catlettsburg, Ky	651	50	30.4	26	5.5	18	15.1	24.9
Portsmouth, Ohio	612	50	31.3	26	7.0	18	16.1	24.3
Cincinnati, Ohio	499	50	31.9	27	10.3	18	18.4	21.6
Louisville, Ky	367	28	11.8	28	6.3	19	8.4	5.5
Evansville, Ind	184	35	23.9	30	9.3	19, 20	13.9	14.6
Paducah, Ky	47	40	18.7	31	8.5	19	11.3	10.2
Allegheny River.								
Warren, Pa	177	7	6.1	22	0.8	14–19	2.2	5.3
Oil City, Pa	123	13	7.0	23	1.5	10–12	2.9	6.5
Parkers Landing, Pa	73	20	8.8	24	1.3	12	3.1	7.5
Freeport, Pa	26	20	15.0	24	1.7	11	5.9	13.3
Conemaugh River.								
Johnstown, Pa	64	7	3.5	23	1.1	16	2.0	2.4
Red Bank Creek.								
Brookville, Pa	35	8	2.3	23	1.0	2-20, 30, 31	1.2	1.3
Beaver River.								
Ellwood Junction, Pa	10	14	7.0	21	0.9	3	1.7	6.1
Cumberland River.								
Burnside, Ky	434	50	11.0	6	3.0	18	5.3	8.0
Carthage, Tenn	257	30	8.5	8	3.0	18	5.2	5.5
Nashville, Tenn	175	40	11.6	10	4.9	19	7.9	6.7
Great Kanawha River.								
Charleston, W. Va	61	30	8.9	25	3 7	17, 18	5.8	5.2
New River.								
Hinton, W. Va	95	14	5.1	24	1.5	16	2.8	3.6
Licking River.								
Falmouth, Ky	30	25	8.5	5, 6	1.2	1–3	3.7	7.3
Miami River.								
Dayton, Ohio	69	18	7.4	21	1.3	16	2.4	6.1
Monongahela River.								
Weston, W. Va	161	18	3.7	20	0.0	10-15, 28-31	0.7	3.7
Fairmont, W. Va	119	25	10.0	21	1.7	31	3.5	8.3
Greensboro, Pa	81	18	15.5	21	7.0	1	9.1	8.5
Lock No. 4, Pa	40	28	19.0	21	7.0	17	9.7	12.0
Cheat River.								
Rowlesburg, W. Va.§	36	14	7.0	20, 21	2.0	19	3.7	5.0
Youghiogheny River.								
Confluence, Pa	59	10	5.4	22–24	1.0	11	2.8	4.4
West Newton, Pa.‖	15	23	7.5	22, 24	0.7	16	2.6	6.8
Muskingum River.								
Zanesville, Ohio	70	20	16.4	22–24	7.7	1, 3, 4	9.8	8.7
Tennessee River.								
Kingston, Tenn	534	25	3.2	6	1.0	17	2.3	2.2
Chattanooga, Tenn	430	33	6.0	7, 22, 23	3.6	18	5.1	2.4
Bridgeport, Ala	390	24	4.4	8	1.9	19	3.3	2.5
Florence, Ala	220	16	4.8	23	2.0	19	3.3	2.8
Johnsonville, Tenn	94	21	7.0	25	3.9	19	5.3	3.1
Clinch River.								
Speers Ferry, Va	156	20	1.5	25	0.2	2, 3, 8, 12, 13, 15, 16	0.5	1.3
Clinton, Tenn	46	25	7.1	8	4.0	17, 18	5.6	3.1
Wabash River.								
Mount Carmel, Ill.†	50	15	11.2	27	2.4	14	5.3	8.8
Red River.								
Arthur City, Tex	688	27	8.3	21	4.3	16, 17	5.1	4.0
Fulton, Ark	565	28	12.6	24	3.0	16–18	5.2	9.6
Shreveport, La	449	29	7.9	28	1.4	17, 18	3.7	6.5
Alexandria, La	139	33	6.0	31	2.2	19	4.0	3.8
Atchafalaya Bayou.								
Melville, La	100*	31	20.0	1	14.6	27, 28	16.8	5.4
Ouachita River.								
Camden, Ark	340	39	10.1	23	5.7	16–18	7.0	4.4
Monroe, La	100	40	13.6	1, 2	9.8	18	12.1	3.8
Yazoo River.								
Yazoo City, Miss	80	25	4.5	28–31	0.2	11	1.9	4.3
Flint River.								
Albany, Ga	80	20	12.0	11	4.6	19	8.2	7.4
Cape Fear River.								
Fayetteville, N. C	100	38	14.6	7	4.6	20	7.1	10.0
Columbia River.								
Umatilla, Oreg	270	25	2.6	3–6	0.0	29–31	1.4	2.6
The Dalles, Oreg	166	40	2.7	1	— 0.8	17, 18	0.7	3.5
Willamette River.								
Albany, Oreg	99	20	14.5	3	3.5	15, 16	6.7	11.0
Portland, Oreg	10	15	8.2	2	2.0	11	4.2	6.2
Edisto River.								
Edisto, S. C	75	6	5.1	6–10	4.2	18, 20	4.7	0.9
James River.								
Lynchburg, Va	257	18	4.2	5, 6	1.1	17–20	2.2	3.1
Richmond, Va	110	12	5.9	6	0.5	16	1.5	5.4
Alabama River.								
Montgomery, Ala	265	35	10.8	6	2.7	18, 19	7.1	8.1
Selma, Ala	212	35	13.4	23	5.6	19, 20	9.4	7.8
Coosa River.								
Rome, Ga	225	30	5.0	6	2.4	30, 31	3.2	2.6
Gadsden, Ala	144	18	5.3	21	2.1	19	3.2	3.2
Tombigbee River.								
Columbus, Miss	285	33	3.5	24	— 2.2	18	—0.1	5.7
Demopolis, Ala	155	35	19.9	23	2.0	18	8.5	17.9
Black Warrior River.								
Tuscaloosa, Ala	90	38	23.9	21	2.1	18	7.1	21.8
Pedee River.								
Cheraw, S. C	145	27	11.5	7	1.7	17, 18, 20	3.9	9.8
Black River.								
Kingstree, S. C	60	12	10.4	1	8.0	17, 20–23	9.0	2.4
Lumber River.								
Fairbluff, N. C	10	6	5.1	11, 12	4.2	24, 25	4.7	0.9

Heights of rivers above zeros of gauges—Continued.

Stations.	Distance to mouth of river.	Danger line on gauge.	Highest water. Height.	Highest water. Date.	Lowest water. Height.	Lowest water. Date.	Mean stage.	Monthly range.
Lynch Creek.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Effingham, S. C.	35	12	9.7	7	6.0	17-19	7.5	3.7
Potomac River.								
Harpers Ferry, W. Va.	170	16	8.8	6	2.3	19,20	3.8	6.5
Roanoke River.								
Clarksville, Va.	155	12	6.7	6	0.9	17	2.2	5.8
Sacramento River.								
Red Bluff, Cal.	241	23	0.6	1	− 0.6	26-31	−0.3	1.2
Sacramento, Cal.	70	25	10.3	1	7.6	13	8.5	2.7
Santee River.								
St. Stephens, S. C.	50	12	7.9	13,14	5.8	22	7.2	2.1
Congaree River.								
Columbia, S. C.	37	15	3.5	6	0.3	18	1.3	3.2
Wateree River.								
Camden, S. C.	45	24	13.1	7	4.4	16	7.3	8.7
Savannah River.								
Augusta, Ga.	130	32	16.2	5	7.9	17,19	10.0	8.3
Susquehanna River.								
Wilkesbarre, Pa.	178	14	10.5	24	3.0	1-6	4.1	7.5
Harrisburg, Pa.	70	17	7.8	25	1.9	18	3.7	5.9
Juniata River.								
Huntingdon, Pa.	80	24	5.9	23	3.2	4	4.0	2.7
W. Br. of Susquehanna.								
Williamsport, Pa.	35	20	8.3	24	1.3	17	3.0	7.0
Waccamaw River.								
Conway, S. C.	40	7	5.6	13,14	3.7	31	4.9	1.9

*Distance to Gulf of Mexico. † Record for 25 days. ‡ Record for 26 days. § Record for 27 days. ‖ Record for 30 days.

THE WEATHER OF THE MONTH.

By A. J. HENRY, Chief of Division of Records and Meteorological Data.

The statistical aspects of the weather of the month are presented in the tables which form the closing part of this REVIEW. Table I, in particular, contains numerous details that are important in the study of climatology. The numerical values in the tables have been generalized in a number of cases, the results appearing on Charts Nos. III to IX, inclusive.

PRESSURE AND WIND.

Normal conditions.—The geographic distribution of normal barometric readings at sea level and under local gravity for December is shown by Chart V of the MONTHLY WEATHER REVIEW for December, 1893.

Normal pressure in December, as in November, is highest over the middle Plateau where it is above 30.20 inches; it is also above 30.20 over eastern Tennessee, the western part of the Carolinas and northern Georgia. Normal pressure in December is lowest over the Gulf of St. Lawrence whence there is a marked gradient toward the permanent area of low pressure on the North Atlantic. Normal pressure is also below 29.95 at Tatoosh Island, Washington, and there is a marked gradient from that place northwestward to the permanent area of low pressure in the North Pacific.

As compared with November, normal pressure increases in all regions except from the middle Plateau to the north Pacific coast.

In December, the prevailing winds on the Atlantic coast are northwesterly or off-shore; in the Gulf States northeasterly or easterly; on the upper Lakes westerly; on the lower Lakes southwesterly; and on the plains east of the Rocky Mountains northwesterly. Elsewhere the winds are more or less variable, no single direction predominating over a considerable stretch of territory.

The current month.—The distribution of mean pressure for the current month is shown on Chart IV. The noteworthy features of the month are (1) the merging of the middle Plateau and South Atlantic highs into one great high, extending from eastern Oregon to Georgia, with a mean pressure of 30.55 inches in southern Idaho; (2) the unusually high pressure that prevailed over the Rocky Mountain and plateau regions.

As compared with November, 1898, mean pressure increased from 0.1 to 0.3 inch from the ninety-fifth meridian westward to the Pacific, the greatest increase being in southern Idaho and western Wyoming. Mean pressure in December decreased slightly in North Carolina and also in the lower Lake region and the St. Lawrence Valley.

Mean pressure was above normal west of a line drawn from Charleston, S. C., to Bismarck, N. Dak. It was below normal in the Lake region, the upper Ohio Valley, the Middle States and New England.

The weather conditions on the Pacific coast were largely dominated by the position and magnitude of the Plateau high.

TEMPERATURE OF THE AIR.

Normal conditions.—The normal temperature of the air in the United States in December varies from about 70° at Key West, 56° at Jacksonville, 55° at New Orleans, 57° at Galveston, 56° at San Diego, to 26° at Eastport, 25° at Burlington, 30° at Buffalo, 29° at Detroit, 18° at Duluth, 6° at St. Vincent, 21° at Havre, 32° at Spokane, and 42° at Seattle, on Puget Sound. The warmest regions are the lower Rio Grande Valley and Florida; the coolest, Minnesota and South Dakota.

In studying the distribution of monthly mean temperatures it will be found very helpful to consult the charts at the end of this REVIEW, especially No. VI, Surface Temperatures, Maximum, Minimum, and Mean. This chart gives a very good idea of the variations of temperature with latitude and longitude, and also of the distribution of normal surface temperatures. Chart VI for any month will differ from a normal chart merely in the displacement or bending of the isotherms northward or southward according as the temperature of the particular locality is above or below the normal for the place and season.

The current month.—The temperature of the month was considerably below normal in all but a very few regions, although the departures on the Atlantic coast and in New England were not large. The greatest deficiencies, 7° to 10° occurred over a large tract of country extending from central Texas northwestward to the State of Washington, and almost coincident with the area of high pressure already noted. Generally from the Mississippi River eastward the departures were less than 5° per day.

The highest maximum temperatures of the month, 80° and over, were registered in Florida, the Lower Rio Grande Valley and southern California. A maximum of 92° was registered at Rio Grande City, Texas. The lowest maximum temperatures of the month 35° to 40°, were observed in portions of Iowa, Wisconsin and Minnesota.

The lowest minimum temperature of the month, 57° below zero, was observed in central Minnesota. Freezing temperatures occurred in all portions of the country, except central and southern Florida and the coastal regions of California.

There was a light cold wave in the Gulf States on the 4th and 5th, in the central Rocky Mountain region and Texas on the 9th and 10th, in New England on the 12th, and quite generally in the central valleys on the 13th and 14th. A light cold wave moved eastward over the Lake region on the 24th and 25th and again on the 27th and 28th. The most severe and widespread cold wave of the month appeared over the northwest on the morning of the 29th. It moved rapidly southward and eastward carrying the line of zero temperature to Oklahoma and the Lake region by the morning of the 31st. During the night of the 31st the cold wave spread eastward to the Atlantic coast, causing zero temperatures in the Middle Atlantic States and falls in temperature from 24° to 38° from the Gulf coast to New England.

The distribution of the observed monthly mean temperature of the air is shown by red lines (isotherms) on Chart VI. This chart also shows the maximum and the minimum temperatures, the former by black and the latter by dotted lines. As will be noticed, these lines have been drawn over the Rocky Mountain Plateau region, although the temperatures have not been reduced to sea level; the isotherms relate, therefore, to the average surface of the country in the neighborhood of the various observers, and as such must differ greatly from the sea-level isotherms of Chart IV.

The average temperatures of the respective geographic districts, the departures from the normal of the current month and from the general mean since the first of the year, are presented in the table below for convenience of reference:

Average temperatures and departures from the normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	10	30.9	− 0.7	+ 13.4	+ 1.2
Middle Atlantic	12	35.8	− 0.5	+ 16.7	+ 1.4
South Atlantic	10	48.0	− 0.6	+ 9.0	+ 0.8
Florida Peninsula	7	60.2	− 1.3	+ 4.0	+ 0.3
East Gulf	7	49.2	− 3.3	− 2.4	− 0.2
West Gulf	7	45.4	− 6.0	+ 4.5	+ 0.4
Ohio Valley and Tennessee	12	34.9	− 3.3	+ 14.3	+ 1.2
Lower Lake	8	28.4	− 2.1	+ 25.4	+ 2.1
Upper Lake	9	21.4	− 3.2	+ 24.6	+ 2.0
North Dakota	7	11.1	− 1.0	+ 18.2	+ 1.5
Upper Mississippi	11	23.3	− 5.2	+ 13.3	+ 1.1
Missouri Valley	10	24.4	− 5.1	+ 13.2	+ 1.1
Northern Slope	7	22.2	− 2.8	+ 0.4	0.0
Middle Slope	6	28.2	− 6.8	+ 0.4	0.0
Southern Slope	5	34.4	− 7.6	− 4.8	− 0.4
Southern Plateau	13	36.5	− 4.4	− 4.2	− 0.4
Middle Plateau	9	23.4	− 5.8	− 15.1	− 1.2
Northern Plateau	11	24.1	− 6.9	− 4.1	− 0.3
North Pacific	9	40.1	− 1.9	+ 6.4	+ 0.5
Middle Pacific	5	47.2	− 1.4	− 7.0	− 0.6
South Pacific	4	52.9	+ 0.2	+ 4.1	+ 0.3

In Canada.—Prof. R. F. Stupart says:

The temperature was a little below average over British Columbia and throughout Ontario, except in the extreme eastern portion, where the average was just maintained; in all the remaining portions of the Dominion it was above average, the excess being particularly marked in the Northwest Territories, and strikingly so in northern Alberta, where Edmonton reports as much as 11° above average. In eastern Canada, Quebec reports the greatest amount above average; namely, 3°, and Halifax, Sydney and Charlottetown each give an excess of 2°. The interior portion of the lower Lake region gives the greatest general amount below average, Brantford and Lucknow each reporting a deficiency of 3°.

PRECIPITATION.

Normal conditions.—Heavy rains in December (4 to 6 inches and over) occur in the Gulf States, lower Mississippi and Ohio valleys, Tennessee, over limited areas on the Atlantic coast and on the coasts of California, Washington and Oregon. The normal rainfall east of the ninety-fifth meridian, excluding the territory above described, is from 1 to 3 inches. Between the ninety-fifth and one hundred and twenty-first meridians the precipitation of November is light in quantity and variable in distribution.

The current month.—The month was relatively one of the driest of the year, less than the normal precipitation being recorded in all but three districts, viz: Florida peninsula, middle and southern slopes. The drought on the middle and South Pacific coasts continued throughout the month. The rainfall of the north Pacific coast was below normal, although the amount that fell was sufficient for all purposes. Heavy rains fell in parts of Florida, southern Georgia, and Alabama, and the precipitation was above the normal for the season from Wyoming southeastward to central Texas and also throughout the southern half of New Mexico and Arizona.

The pressure distribution in the Plateau region and on the Pacific coast was typical of a dry season on the coast, but favorable to heavy snow in Arizona and New Mexico. (See Chart VI, Bulletin D, Rainfall of the United States.)

The geographic distribution of precipitation is shown on Chart III, and the numerical values for about 3,000 stations appear in Tables II and III, while the details as to excessive rains will be found in Table XI.

The usual details appear in the table below:

Average precipitation and departures from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		Inches.	Inches.
New England	10	2.55	70	−1.10	+ 5.70
Middle Atlantic	12	2.62	79	−0.70	− 0.70
South Atlantic	10	2.58	74	−0.90	− 6.70
Florida Peninsula	7	3.83	151	+1.30	− 5.60
East Gulf	7	3.91	91	−0.40	+ 2.30
West Gulf	7	2.40	73	−0.90	− 4.90
Ohio Valley and Tennessee	12	2.22	63	−1.30	− 0.20
Lower Lake	8	2.73	96	−0.10	+ 0.10
Upper Lake	9	1.24	55	−1.00	− 2.20
North Dakota	7	0.27	40	−0.40	− 0.80
Upper Mississippi	11	0.78	39	−1.20	+ 5.00
Missouri Valley	10	0.72	59	−0.50	+ 2.70
Northern Slope	7	0.30	60	−0.20	− 0.30
Middle Slope	6	1.41	155	+0.50	+ 2.80
Southern Slope	6	1.97	155	+0.70	− 2.80
Southern Plateau	13	0.83	67	−0.40	− 2.90
Middle Plateau	9	0.72	47	−0.80	− 2.20
Northern Plateau	11	1.08	50	−1.10	− 3.90
North Pacific	9	6.74	75	−2.20	− 8.30
Middle Pacific	5	1.93	34	−3.70	−13.90
South Pacific	4	0.52	17	−2.60	− 9.20

In Canada.—Professor Stupart says:

The precipitation was a little above average in the western and southwestern portions of the lower Lake region, also from the eastern portion of Lake Superior to about the Ottawa River and embracing the Georgian Bay district. In Cape Breton it was also above average, but seemingly local, whilst in all other portions of Canada it was below average, especially in the Province of Quebec and over Vancouver Island. In the former Province there occurred at Quebec a deficiency of 1.5 inch, and at Father Point 1.6 inch; Victoria, in Vancouver Island records 4.1 inches less than average. In nearly all parts of the Dominion the precipitation was largely snow, and in Ontario, Quebec, and the Maritime Provinces, some heavy falls occurred. The snow storm of the 4th and 5th over Ontario was exceptionally heavy. During this storm Orangeville reports that 28 inches fell, and Collingwood 24 inches. The snowfall during the month in the immediate neighborhood of Owen Sound was phenomenally heavy, the total fall at Owen Sound being reported as 8 feet 3 inches.

SLEET.

The following are the dates on which sleet fell in the respective States:

Alabama, 8, 9, 10, 15, 30, 31. Arkansas, 3, 4, 11, 31. California, 28, 29, 30, 31. Colorado, 18. Connecticut, 4, 19, 20,

31. Delaware, 31. District of Columbia, 31. Georgia, 4, 9, 22, 25. Idaho, 24, 28. Illinois, 1, 2, 3, 12, 16, 18, 19, 20, 21, 22, 29, 30. Indiana, 6, 16, 17, 19, 30, 31. Indian Territory, 3, 11, 17. Iowa, 1, 15, 17, 18, 19, 20, 21. Kansas, 8, 9, 13, 23, 26. Kentucky, 4, 16, 30, 31. Louisiana, 3, 8, 9, 10, 13, 14, 15, 30, 31. Maine, 5, 20. Maryland, 3, 17, 19, 31. Massachusetts, 4, 19, 20, 31. Michigan, 2, 4, 5, 19, 20, 30, 31. Minnesota, 19, 20, 26. Missouri, 3, 11, 12, 18, 19, 21, 22, 30. Montana, 1, 19. Nebraska, 19. Nevada, 20. New Hampshire, 4, 5, 20, 21, 30, 31. New Jersey, 4, 17, 19, 20, 31. New Mexico, 8, 9, 10, 17. New York, 4, 17, 19, 20, 21, 22, 31. North Carolina, 2, 3, 4, 11, 12, 13, 31. North Dakota, 20, 28. Ohio, 4, 19, 30. Oklahoma, 8. Oregon, 1, 11, 13, 14, 17, 18, 19, 20, 21, 28, 29, 30, 31. Pennsylvania, 4, 5, 17, 19, 20, 31. South Carolina, 8, 9, 10, 12, 15, 25. South Dakota, 6, 7, 12, 20. Tennessee, 4, 17, 30, 31. Texas, 7, 8, 9, 14, 15, 18, 19, 24, 31. Utah, 2. Vermont, 4, 5, 20, 21. Virginia, 3, 4, 11, 17, 31. Washington, 4, 6, 18, 19, 20. West Virginia, 4, 17, 19, 31. Wisconsin, 19, 20, 24. Wyoming, 30.

HAIL.

The following are the dates on which hail fell in the respective States:

Alabama, 2. Arizona, 8, 9, 10. Arkansas, 31. California, 8, 9, 19, 20, 29, 30. Washington, 17, 19.

SNOWFALL.

The total snowfall for the current month is given in Tables I and II, and its geographic distribution is shown on Chart VIII. The limit of snow at the end of the month was much farther south than at the same time a year ago. The snowfall of the Plateau region as a whole was perhaps a little above the average, although the fall over small areas here and there was not up to the average. The snowfall of the mountainous regions of Arizona, New Mexico and Colorado, from the best information available, seems to have been considerably above the average. The snowfall of the upper Mississippi and Missouri Valleys was a trifle heavier than for the corresponding month a year ago, while the average depth in New England was not so great as in 1897. Little snow fell east of the Appalachians south of Lynchburg, Va., and the fall of western Georgia and Alabama was also quite light. The fall of the Sierra Nevadas in California seems to have been below the average.

The depth of snow on the ground at the end of the month.—The southern limit of snow on the ground at the close of the month was slightly farther south than on the corresponding date a year ago. The ground was free from snow, however, over considerable areas north of the southern limit of no snow, particularly in southern Ohio and Indiana, Illinois and a considerable portion of North Dakota. A greater portion of the Plateau region was covered with snow at the end of the month than was the case a year ago; and this was also the case on the Upper Peninsula of Michigan and in northern Wisconsin.

HUMIDITY.

The humidity observations of the Weather Bureau are divided into two series; the first or tridaily series began in 1871 and ended with 1887; the second or twice-daily series is continuous from 1888 to the present time.

The monthly means of the second or present series are based upon observations of the whirled psychrometer at 8 a. m. and 8 p. m., seventy-fifth meridian time, which corresponds to 5 a. m. and 5 p. m., Pacific; 6 a. m. and 6 p. m., Mountain; and 7 a. m. and 7 p. m., Central standard time.

Mean values computed from the first series are naturally not directly comparable with those of the second. In general the means of the first series are lower than those of the second, since they include an observation in the afternoon when the relative humidity of the air is near the minimum of the day. At stations in the western plateau region, however, the converse holds good, the means of the second series being lower than those of the first by amounts ranging from 0 to 10 per cent on the average of the year.

In the present state of knowledge respecting the diurnal variation in the moisture of the air, we are scarcely warranted in combining the two series in a general mean.

In using the table by means of which the amount of moisture in the air is computed from the readings of the wet and dry bulb thermometers, the pressure argument has almost always been neglected, an omission that has little significance except for low temperatures and at high stations, such as Santa Fe, El Paso, Cheyenne, and a few others. The failure to apply a correction for the influence of pressure on the evaporation and therefore on the temperature of the wet-bulb thermometer has had the effect of making the monthly means of relative humidity at high-level stations too small by quantities ranging from 5 to 10 per cent. In the application of the monthly averages of the above table, or those of individual stations in Table I, to special inquiries, whether in the departments of biology, climatology, or sanitary science, this fact should be kept in mind. It should also be remembered that the hours at which observations in the Rocky Mountain Plateau region are made, viz, at 5 or 6 local mean time, morning and afternoon, give approximately the maximum and minimum values of the relative humidity for the day; probably the means of such hours approach more nearly the true mean of the month than is the case on the Atlantic seaboard and in the seventy-fifth meridian time belt.

The current month.—The month was cold and deficient in rainfall in a majority of districts, and we should, therefore, expect low absolute humidity and relatively clear skies.

Relative humidity was above normal in seven districts, exactly normal in five and below in the remaining nine, as against six, four, and eleven, respectively, in November, 1898, whence it appears there was a slight increase in the relative humidity of the air but not in the absolute humidity.

The greatest changes in the relative humidity of the current, as compared with the preceding, month occurred in the southern Plateau, viz: from 10 per cent below normal to 1 per cent above. The drought on the Pacific coast, noted in the November REVIEW was intensified considerably during December, there being an increase in the dryness of the air throughout the entire region.

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
	%			%	
New England	76	+1	Missouri Valley	75	0
Middle Atlantic	74	0	Northern Slope	68	+1
South Atlantic	75	−4	Middle Slope	71	+6
Florida Peninsula	82	0	Southern Slope	72	+5
East Gulf	75	−3	Southern Plateau	49	+1
West Gulf	73	0	Middle Plateau	65	−2
Ohio Valley and Tennessee	75	0	Northern Plateau	81	0
Lower Lake	77	−1	North Pacific Coast	82	−6
Upper Lake	83	+2	Middle Pacific Coast	66	−18
North Dakota	78	−1	South Pacific Coast	56	−18
Upper Mississippi Valley	78	+2			

WIND.

The winds of the month were not unusually boisterous for the season. The Gulf storm of the 4th and 5th was attended by winds of high velocity in its course from the Mississippi Valley to the Lakes. The majority of the high velocities

given in the table below occurred in connection with that storm.

The maximum wind velocity at each Weather Bureau station for a period of five minutes is given in Table I, which also gives the altitude of Weather Bureau anemometers above ground.

Following are the velocities of 50 miles and over per hour registered during the month:

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Albany, N. Y	4	54	e.	El Paso, Tex	3	52	ne.
Do	5	60	ne.	Fort Canby, Wash	1	54	se.
Atlantic City, N. J	4	50	se.	Do	10	50	e.
Baltimore, Md	4	54	e.	Do	18	78	se.
Block Island, R. I	4	69	e.	Do	26	50	se.
Do	5	64	e.	Do	31	64	se.
Boston, Mass	5	50	e.	Havre, Mont	27	50	sw.
Buffalo, N. Y	5	55	w.	Independence, Cal	28	60	nw.
Do	6	52	w.	Do	29	66	nw.
Do	7	58	w.	Knoxville, Tenn	4	50	sw.
Do	8	51	w.	Mount Tamalpais, Cal.	8	55	ne.
Do	10	62	w.	Do	9	61	ne.
Do	11	51	sw.	Do	28	62	nw.
Do	14	54	w.	Do	29	60	nw.
Do	18	51	w.	Nantucket, Mass	4	52	se.
Do	22	58	w.	Do	5	54	se.
Do	23	68	sw.	New Haven, Conn	5	54	se.
Do	24	50	w.	New York, N. Y	4	78	e.
Do	27	56	w.	Do	5	54	nw.
Cape May, N. J	4	67	e.	Do	13	50	w.
Cleveland, Ohio	5	60	w.	Do	28	60	w.
Do	22	50	sw.	Portland, Me	5	50	e.
Do	27	51	w.	Winnemucca, Nev	8	52	n.
Eastport, Me	5	72	e.	Do	28	51	nw.

It will be noticed on examination of the above table that maximum wind velocities of over 50 miles per hour occurred at two stations on the middle Plateau (Winnemucca, Nev., and Independence, Cal.) on the 28th.

On turning to the daily weather maps of that date, we were unable to find any explanation of the high winds in the pressure gradients as delineated on the morning or night charts. On examining the barograph trace of the Winnemucca station, however, it seems quite probable that a secondary depression formed in the Great Basin during the 28th and moved eastward north of Carson City and Winnemucca, passing the latter point at about 6 p. m., seventy-fifth meridian time.

High winds prevailed on the California coast on the 9th, and over southern California on the 23d–24th, the latter being accompanied by clouds of dust blown from the deserts to the northeastward.

The winds on the western slope of the Rocky Mountains, particularly over northeastern Utah, were destructive on the night of the 8–9th. Buildings were unroofed, and in a few cases wrecked, and there was general destruction of shade trees, awnings, signs, etc.

SUNSHINE AND CLOUDINESS.

The quantity of sunshine, and therefore of heat, received by the atmosphere as a whole is very nearly constant from year to year, but the proportion received by the surface of the earth depends upon the absorption by the atmosphere, and varies largely with the distribution of cloudiness. The sunshine is now recorded automatically at 21 regular stations of the Weather Bureau by its photographic and at 47 by its thermal effects. The photographic record sheets show the apparent solar time, but the thermometric records show seventy-fifth meridian time; for convenience the results are all given in Table IX for each hour of local mean time. In order to complete the record of the duration of cloudiness these registers are supplemented by special personal observations of the state of the sky near the sun for an hour after sunrise and before sunset, and the cloudiness for these hours has been added as a correction to the instrumental records, whence there results a complete record of the duration of sunshine from sunrise to sunset.

The average cloudiness of the whole sky is determined by numerous personal observations at all stations during the daytime, and is given in the column "average cloudiness" in Table I; its complement, or percentage of clear sky, is given in the last column of Table IX for the stations at which instrumental self-registers are maintained.

The percentage of clear sky (sunshine) for all of the stations included in Table I, obtained as described in the preceding paragraph, is graphically shown on Chart VII. The regions of cloudy and overcast skies are shown by heavy shading; an absence of shading indicates, of course, the prevalence of clear, sunshiny weather.

The formation of fog and cloud is primarily due to differences of temperature in a relatively thin layer of air next to the earth's surface. The relative position of land and water surfaces often greatly increases the tendency to form areas of cloud and fog. This principle is perhaps better exemplified in the Lake region than elsewhere, although it is of quite general application. The percentage of sunshine on the lee shores of the Lakes is always much less than on the windward shores. Next to the permanent influences that tend to form fog and cloud may be classed the frequency of the passage of cyclonic areas.

The current month.—Considering the high pressure that prevailed during the month, we should expect relatively clear skies west of the Mississippi. This was so only in a measure, as may be seen by the departures in the table below. There was more than the normal cloudiness over the southern Plateau, particularly in southwestern Arizona, which region is, ordinarily, more free from clouds than any other. The influence of the Great Lakes in producing cloud is remarkably well shown on the chart for the current month, No. VII. The vertical temperature gradient of the cold, dry air that moves easterly over the comparatively level lands of Minnesota and Wisconsin is probably not disturbed, at least in fair weather, until the lakes are reached, and so long as it remains constant, or nearly so, there is no tendency to form cloud. When, however, the relatively warmer air over the lakes is reached, a portion of the water vapor in the air is condensed and becomes visible as cloud, and the latter is carried eastward in the prevailing winds. The greatest effect is naturally felt on the eastern shore of the lakes whose longer axis runs at right angles, or nearly so, to the direction of the prevailing winds. The clouds formed over Lake Michigan are not immediately dissolved as soon as they pass beyond the shores of the lake, but are carried eastward, giving character to the weather over the interior of the State and even beyond. One of the direct results of the cloudiness of the eastern shore of Lake Michigan is the immunity from severe frosts and extremely low temperatures enjoyed by that region.

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	5.9	+0.1	Missouri Valley	4.5	−0.6
Middle Atlantic	5.5	+0.1	Northern Slope	4.5	−0.1
South Atlantic	5.5	+0.8	Middle Slope	3.6	−0.4
Florida Peninsula	5.0	+0.4	Southern Slope	3.6	−0.8
East Gulf	5.6	+0.4	Southern Plateau	3.2	+0.2
West Gulf	5.1	−0.2	Middle Plateau	4.4	−0.7
Ohio Valley and Tennessee	5.5	−0.6	Northern Plateau	6.3	−0.8
Lower Lake	8.0	+0.4	North Pacific Coast	6.7	−0.6
Upper Lake	6.5	−0.6	Middle Pacific Coast	4.7	−0.7
North Dakota	4.1	−1.1	South Pacific Coast	3.8	−0.6
Upper Mississippi Valley	4.5	−1.2			

ATMOSPHERIC ELECTRICITY.

Numerical statistics relative to auroras and thunderstorms are given in Table IX, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.

Thunderstorms.—One hundred and forty-eight reports of thunderstorms were received during the current month as against 192 in 1897, and 333 during the preceding month.

The dates on which the number of reports of thunderstorms for the whole country were most numerous were: 22d, 40; 20th, 32; 3d, 11; 4th, 11.

Reports were most numerous from South Carolina, 21; Georgia, 18; New Jersey, 18; North Carolina, 18.

Auroras.—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz, from the 23d to the end of the month.

The greatest number of reports were received for the following dates: 13th, 10; 12th, 6; 18th, 4.

Reports were most numerous from Minnesota, 9; Montana, 8; Ohio, 7.

In Canada.—Auroras were reported as follows: Father Point, 15; Quebec, 6, 18; White River, 14, 28; Winnipeg, 14; Minnedosa, 8, 11, 14, 16, 17, 18, 19; Qu'Appelle, 14, 17, 18; Banf, 14; Prince Albert, 9; Battleford, 14, 16.

NOTES ON THE WEATHER OF THE WEST INDIES.

No serious atmospheric disturbances were observed during the month. Generally tranquil weather, characteristic of the Tropics, was noted at all stations.

Thunderstorms were observed as follows: Colon, 11th; Roseau, 25th; Santo Domingo, 29th.

Rain from clear sky.—The observer at Dominica reports the occurrence of a heavy shower with clear sky overhead about noon of the 16th. His explanation of the phenomenon is that the rain was blown from clouds overhanging the hills near by.

Water temperatures.—The observer at Porto Rico records in his daily journal a number of observations upon the temperature of the water of the bay and ocean near San Juan made on December 16.

The observations were taken at the surface, and the resulting temperature is closely the mean temperature of the air for the year (79°), and considerably higher than the mean temperature for the past week, (76.0°.)

It is interesting to find that the temperature of the long, narrow, black-bottomed channel of San Antonio is the same as that of the open bay. It connects the bay with the small, open harbor of San Antonio where the temperature was higher. It is surprising to find the open mouth of San Antonio warmer than the large bay of San Juan, and the open mouth of the latter colder. The mouths are only 2¼ miles apart. San Antonio has heavy reefs outside, but a heavy surf rolls up to the very mouth and small vessels can enter it.

While the sun was unclouded (from 1:10 to 2:29) the air was 1.7° warmer than the water, but when it clouded (from 2:33 to 3:24) it was 2.4° colder.

Summed up, the observations give the following results:

			°
In San Juan Bay proper	19 observations,	mean	78.2
In San Antonio channel	6	"	78.2
In San Antonio harbor	3	"	78.3
At mouth of San Antonio harbor with open sea pouring in. (The depth here is about 10 feet.)	3	"	78.9
Near the mouth of San Juan Bay	2	"	78.0
At mouth of San Juan Bay (off Morro Castle) in the main channel, which is deep	3	"	77.5

CLIMATE AND CROP SERVICE.

By JAMES BERRY, Chief of Climate and Crop Service Division.

The following extracts relating to the general weather conditions in the several States and Territories are taken from the monthly reports of the respective sections of the Climate and Crop Service. The name of the section director is given after each summary.

Rainfall is expressed in inches.

Alabama.—The mean temperature was 42.0°, or 2.5° below normal; the highest was 78°, at Bermuda on the 21st, and the lowest, 8°, at Madison on the 14th. The average precipitation was 3.58, or 0.12 below normal; the greatest monthly amount, 8.25, occurred at Elba, and the least, 1.51, at Hamilton.—*F. P. Chaffee*.

Arizona.—The mean temperature was 40.4°, or 4.6° below normal; the highest was 84°, at Champies Camp on the 1st, and the lowest, 21° below zero, at Holbrook on the 13th. The average precipitation was 1.73, or 0.07 above normal; the greatest monthly amount, 5.80, occurred at Tuba, and the least, 0.16, at Music Mountain.—*W. G. Burns*.

Arkansas.—The mean temperature was 39.5°, or 3.9° below normal, the highest was 76°, at Texarkana on the 29th, and the lowest, 4° below zero at Keesees Ferry on the 14th. The average precipitation was 1.87, or 2.89 below normal; the greatest monthly amount, 3.68, occurred at Mossville, and the least, 0.56, at Dallas.—*E. B. Richards*.

California.—The mean temperature was 44.4°, or 2.3° below normal; the highest was 98°, at Tropico on the 2d, and the lowest, 12° below zero, at Boca on the 30th. The average precipitation was 1.20, or 2.77 below normal; the greatest monthly amount, 6.07, occurred at Crescent City, while none fell at Chino.—*W. H. Hammon*.

Colorado.—The mean temperature was 19.5°, or 7.0° below normal; the highest was 68°, at Cheyenne Wells on the 28th, and the lowest, 40° below zero, at Garnett on the 31st. The average precipitation was 0.86, or about 0.14 below normal; the greatest monthly amount, 4.18, occurred at Santa Clara, and the least, 0.08, at Delta.—*F. H. Brandenburg*.

Florida.—The mean temperature was 57.5°, or 3.5° below normal; the highest was 90°, at Ocala on the 3d, and the lowest, 21°, at Crawfordville on the 27th. The average precipitation was 4.12, or 1.32 above normal; the greatest monthly amount, 11.80, occurred at St. Andrews Bay, and the least, 1.89, at Manatee.—*A. J. Mitchell*.

Georgia.—The mean temperature was 46.6°, or 2.7° below normal; the highest was 80°, at Mauzy on the 30th, and the lowest, 8°, at Diamond on the 15th and at Tallapoosa on the 13th. The average precipitation was 3.79, or 0.18 above normal; the greatest monthly amount, 6.98, occurred at Fort Gaines, and the least, 0.60, at Cartersville.—*J. B. Marbury*.

Illinois.—The mean temperature was 26.8°, or 3.9° below normal; the highest was 64°, at Equity on the 29th and at Cairo and New Burnside on the 30th; the lowest, 12° below zero, at Scales Mound on the 14th. The average precipitation was 1.38, or 0.82 below normal; the greatest monthly amount, 2.78, occurred at Tuscola, and the least, 0.34, at Lanark.—*C. E. Linney*.

Indiana.—The mean temperature was 28.8°, or 4.2° below normal; the highest was 66°, at Marengo on the 19th, and the lowest, 26° below zero, at Cambridge City on the 14th. The average precipitation was 2.23, or 0.53 below normal; the greatest monthly amount, 3.59 occurred at Knightstown, and the least, 0.60, at Valparaiso.—*C. F. R. Wappenhans*.

Iowa.—The mean temperature was 18.1°, or about 5.0° below normal; the highest was 60°, at Wapello on the 29th, and the lowest, 25° below zero, at Estherville, Mason City, and Ruthven on the 31st. The average precipitation was 0.48, or more than 1.00 below normal; the greatest monthly amount, 1.70, occurred at Eldora, and the least, trace, at Mason City.—*G. M. Chappel*.

Kansas.—The mean temperature was 27.8°, or 6.0° below normal; the highest was 66°, at Marion on the 27th, at Oswego on the 28th, and at Fort Scott on the 30th; the lowest was 23° below zero, at Achilles on the 31st. The average precipitation was 1.73, or 0.72 above normal; the greatest monthly amount, 3.62, occurred at Lebo, and the least, 0.29, at Achilles.—*T. B. Jennings*.

Kentucky.—The mean temperature was 34.1°, or 4.2° below normal; the highest was 70°, at Ashland on the 30th, and the lowest, 12°

below zero, at Eubank on the 14th. The average precipitation was 2.74, or 0.53 below normal; the greatest monthly amount, 4.57, occurred at Caddo, and the least, 1.31, at Irvington.—*H. B. Hersey.*

Louisiana.—The mean temperature was 47.4°, or 5.2° below normal; the highest was 80°, at Jennings on the 20th, and the lowest, 11°, at Oxford on the 10th. The average precipitation was 3.03, or 1.19 below normal; the greatest monthly amount, 7.33, occurred at Port Eads, and the least, 1.56, at Montgomery.—*A. G. McAdie.*

Maryland and Delaware.—The mean temperature was 35.0°, or 1.5° below normal; the highest was 70°, at Pocomoke City, Md., on the 4th and 22d, and the lowest, 20° below zero, at Deerpark, Md., on the 15th. The average precipitation was 3.54, or 1.04 above normal; the greatest monthly amount, 6.26, occurred at Smithsburg, Md., and the least, 1.85, at Boettcherville, Md.—*F. J. Walz.*

Michigan.—The mean temperature was 23.1° or 3.4° below normal; the highest was 54°, at Fairview on the 18th and at Mottville on the 29th, and the lowest, 35° below zero, at Humboldt on the 31st. The average precipitation was 1.87, or 0.25 below normal; the greatest monthly amount, 3.62, occurred at Ivan, and the least, 0.25, at Port Austin.—*C. F. Schneider.*

Minnesota.—The mean temperature was 11.9°, or about 2.5° below normal; the highest was 54°, at Two Harbors on the 17th, and the lowest, 57° below zero, at Pokegama on the 31st. The average precipitation was 0.18, or about 0.50 below normal; the greatest monthly amount, 0.64, occurred at Pokegama, while none fell at St. Cloud.—*T. S. Outram.*

Mississippi.—The mean temperature was 43.5°, or more than 5.0° below normal; the highest was 78°, at Waynesboro on the 2d and at Natchez on the 30th, and the lowest, 7°, at Ripley on the 13th. The average precipitation was 2.09, or about 1.50 below normal; the greatest monthly amount, 5.78, occurred at Biloxi, and the least, 1.34, at Louisville.—*W. T. Blythe.*

Missouri.—The mean temperature was 28.8°, or 5.9° below normal; the highest was 74°, at New Palestine on the 29th, and the lowest, 20° below zero, at Eldon on the 14th. The average precipitation was 1.69, or 0.68 below normal; the greatest monthly amount, 3.55, occurred at Lebanon, and the least, 0.50, at Downing.—*A. E. Hackett.*

Montana.—The mean temperature was 20.8°, or 3.5° below normal; the highest was 64°, at Utica on the 26th, and the lowest, 37° below zero, at Kipp on the 31st. The average precipitation was 0.41, or 0.21 below normal; the greatest monthly amount, 1.89, occurred at Marysville, and the least, trace, at Darby.—*E. J. Glass.*

Nebraska.—The mean temperature was 23.5°, or about 2.0° below normal; the highest was 83°, at Fort Robinson on the 20th, and the lowest, 22° below zero, at Lodgepole on the 8th and at Camp Clarke and Hay Springs on the 9th. The average precipitation was 0.32, or about 0.35 below normal; the greatest monthly amount, 1.72, occurred at Auburn, while none fell at several western stations.—*G. A. Loveland.*

Nevada.—The mean temperature was 25.3°, or about 5.0° below normal; the highest was 70°, at Panaca on the 1st, and the lowest, 15° below zero, at Elko on the 24th. The average precipitation was 0.48, or 0.81 below normal; the greatest monthly amount, 2.40, occurred at Lewers Ranch, and the least, trace, at Bunkerville, Hot Springs, and Panaca.—*R. F. Young.*

New England.—The mean temperature was 26.4°, or 1.3° below normal; the highest was 58°, at Boston, Mass., on the 30th, and the lowest, 30° below zero, at Fairfield, Me., Berlin Mills., N. H., and Woodstock, Vt., on the 14th. The average precipitation was 2.43, or 1.08 below normal; the greatest monthly amount, 8.30, occurred at Jacksonville, Vt., and the least, 0.75, at Burlington, Vt.—*J. W. Smith.*

New Jersey.—The mean temperature was 33.3°, or 0.9° below normal; the highest was 66°, at Toms River and Oceanic on the 30th, and the lowest was 2° below zero, at Riverdale on the 14th. The average precipitation was 3.53, or 0.42 above normal; the greatest monthly amount, 4.85, occurred at Bridgeton, and the least, 2.38, at Deckertown.—*E. W. McGann.*

New Mexico.—The mean temperature was 28.6°, or 6.4° below normal; the highest was 75°, at Eddy on the 1st, and the lowest, 30° below zero, at Buckmans on the 22d. The average precipitation was 1.19, or 0.29 above normal; the greatest monthly amount, 2.62, occurred at Folsom, and the least, 0.40, at Bluewater and Santa Fe—*R. M. Hardinge.*

North Carolina.—The mean temperature was 42.1°, or 0.5° below normal; the highest was 75°, at Newbern and Sloan on the 20th, and the lowest, 4° below zero, at Linville on the 15th. The average precipitation was 2.74, or 1.01 below normal; the greatest monthly amount, 5.69, occurred at Highlands, and the least, 1.09, at Murphy.—*C. F. von Herrmann.*

North Dakota.—The mean temperature was 12.1°, or 1.0° below normal; the highest was 55°, at Ellendale and Forman on the 28th, and the lowest, 38° below zero, at Woodbridge on the 31st. The average precipitation was 0.27, or 0.24 below normal; the greatest monthly amount, 0.87, occurred at Forman, and the least, trace, at Buxton, Melville, Steele, and Willow City.—*B. H. Bronson.*

Ohio.—The mean temperature was 28.8°, or 3.6° below normal; the highest was 67°, at Clarksville on the 29th, and the lowest, 18° below zero, at McArthur and Milligan on the 14th. The average precipitation was 2.71, or about normal; the greatest monthly amount, 4.64, occurred at Ashtabula, and the least, 1.02, at Annapolis.—*J. Warren Smith.*

Oklahoma.—The mean temperature was 34.7°; the highest was 77°, at Fort Sill on the 29th, and the lowest, 2° below zero, at Prudence on the 23d. The average precipitation was 2.73; the greatest monthly amount, 5.20, occurred at Pawhuska, and the least, 1.38, at Tahlequah.—*J. I. Widmeyer.*

Oregon.—The mean temperature was 34.4°, or 3.5° below normal; the highest was 70°, at Prineville on the 1st, and the lowest was 10° below zero, at Silverlake on the 12th. The average precipitation was 4.00, or 2.96 below normal; the greatest monthly amount, 16.51, occurred at Nehalem, and the least, 0.28, at Riverside.—*B. S. Pague.*

Pennsylvania.—The mean temperature was 29.8°, or 2.2° below normal; the highest was 68°, at Warren on the 30th, and the lowest, 11° below zero at Dyberry on the 14th. The average precipitation was 2.98, or about 0.16 below normal; the greatest monthly amount, 4.79, occurred at Somerset, and the least, 1.31, at Franklin.—*T. F. Townsend.*

South Carolina.—The mean temperature was 49.5°, or 2.4° below normal; the highest was 77°, at Gillisonville on the 20th, and the lowest, 9°, at Walhalla on the 13th, and at Greenville and Holland on the 15th. The average precipitation was 2.84, or 0.30 below normal; the greatest monthly amount, 6.52, occurred at Gillisonville, and the least, 1.02, at Cheraw.—*J. W. Bauer.*

South Dakota.—The mean temperature was 19.2°, or about 3.0° below normal; the highest was 64°, at Chamberlain on the 28th, and the lowest, 29° below zero, at Ladelle on the 13th. The average precipitation was 0.14, or 0.74 below normal; the greatest monthly amount, 1.10, occurred at Fort Meade, and the least, trace, at several stations.—*S. W. Glenn.*

Tennessee.—The mean temperature was 37.4°, or about 3.5° below normal; the highest was 71°, at Yukon on the 30th, and the lowest, 8° below zero, at Springdale on the 14th. The average precipitation was 2.56, or more than 1.00 below normal; the greatest monthly amount, 4.20, occurred at McKenzie, and the least, 1.00 at Liberty.—*H. C. Bate.*

Texas.—The mean temperature for the State, determined by comparison of 32 stations, well distributed, was 9.3° below the normal, which shows that December, 1898, was an exceptionally cold month. The deficiency in temperature at the several stations ranged from 3.0° to 13.9°, with the greatest over the northeastern portion of the State. The highest temperature was 92°, at Fort Ringgold on the 1st, and the lowest, 2° below zero, at Tulia on the 10th. The average precipitation for the State, determined by comparison of 31 stations distributed throughout the State, was 0.06 below the normal. There was a slight excess over west Texas and the central portion of the coast district, and nearly normal conditions prevailed elsewhere, except over southwest Texas, and the eastern and western portion of the coast district, where there was a slight deficiency, with greatest, 1.75, over the east coast district. The greatest monthly amount, 4.08, occurred at Brenham and at Jacksonville, and the least, trace, at Fort Ringgold and Point Isabel. Snow was reported from all stations except over the extreme southern portion of the State, and traces fell at Galveston on the 9th, 10th, and 14th. The greatest local amount was 10.5 inches at Tulia.—*I. M. Cline.*

Utah.—The mean temperature was 23.3°; the highest was 72°, at Ferron on the 1st, and the lowest, 17° below zero, at Fort Du Chesne on the 30th and 31st. The average precipitation was 0.64; the greatest monthly amount, 1.85, occurred at Thistle, and the least, trace, at Tropic—*J. H. Smith.*

Virginia.—The mean temperature was 38.3°, or about 1.7° below normal; the highest was 74°, at Spottville on the 21st, and the lowest, 2° below zero, at Marion on the 14th. The average precipitation was 3.02, or 0.06 below normal; the greatest monthly amount, 6.10, occurred at Columbia, and the least, 1.35, at Hampton.—*E. A. Evans.*

Washington.—The mean temperature was 31.0°, or nearly 6.0° below normal; the highest was 71°, at Kennewick on the 26th, and the lowest, 13° below zero, at Usk on the 13th. The average precipitation was 3.97, or 2.50 below normal, and is the least December precipitation on record; the greatest monthly amount, 18.05, occurred at Clearwater, and the least, 0.06, at Sunnyside.—*G. N. Salisbury.*

Wisconsin.—The mean temperature was 15.5°, or 4.9° below normal; the highest was 60°, at Prairie du Chien on the 16th, and the lowest, 40° below zero, at Osceola on the 31st. The average precipitation was 0.39, or 0.73 below normal; the greatest monthly amount, 1.75, occurred at Bayfield, while none fell at Spooner.—*W. M. Wilson.*

Wyoming.—The mean temperature was 17.4°, or 6.4° below normal; the highest was 60°, at Hecla on the 14th, and at Sheridan and Wheatland on the 28th; the lowest was 30° below zero, at Bigpiney on the 9th. The average precipitation was 0.64, or 0.03 below normal; the greatest monthly amount, 2.50, occurred at Sherman, while none fell at Bigpiney.—*W. S. Palmer.*

SPECIAL CONTRIBUTIONS.

THE THUNDERSTORM OF SEPTEMBER 17-18, 1895.

By ALFRED J. HENRY.

In September, 1895, I had occasion to trace the progress of the front of a thunderstorm across the country by means of the pressure oscillations as given by the barographs at stations in the storm track. The particularly interesting feature of that storm was the fact that it preserved its vigor during the night hours, and was curiously deflected southward on reaching central New York. Copies of some of the barograph traces illustrating the advance of this storm are given on Chart XI. By combining the observations at voluntary with those at regular stations, I have been able to draw approximate isobronts, as shown on Chart XII *a*.

Attention is called particularly to the rapidity of motion along the axis of the lower lakes, as compared with adjacent land areas. The line of thunderstorms was deflected southeastward after reaching central New York, but does not seem to have extended to Norfolk, Va. Rain fell in southern New England during the forenoon of the 18th, the conditions which produced the fall apparently advancing from the westward in the line of the original thunderstorm disturbance.

Copies of extracts from the daily journals are given in the following appendix for Weather Bureau stations in the line of progress of the general thunderstorm disturbance:

EXTRACTS FROM THE DAILY JOURNALS FOR SEPTEMBER 17-18, 1895, AT STATIONS NAMED.

Marquette, Mich., 17th.—Clear until 9:30, when clouds increased until the sky was cloudy; light rain began 3:35 p. m. ending 5:38 p. m.; thunderstorm; first thunder heard at 5:05 p. m.; loudest, 5:20 p. m., and last 10:34 p. m.; storm came from the southwest, and moved toward the east-northeast; temperature before the storm, 56°; after, —; direction of the wind before the storm, east; after, —; thunder was heard until 7:58 p. m. as distant rumbles, it then grew louder with bright flashes of lightning in northwest, north, northeast, and east; light rain began, 7:55 p. m.; ending 10 p. m.

18th.—Fair at times during the morning; partly cloudy to clear in the afternoon.

Sault Ste. Marie, Mich., 17th.—Clear during forenoon, becoming cloudy toward evening; light rain began 7:24 p. m., continuing at midnight; much colder all day; rising brometer until noon, then falling sharply and fluctuating considerably between 6 p. m. and midnight; light to fresh variable winds, principally from northwest to northeast until 1:30 p. m., then becoming southwest to southeast; brisk southeast winds began at 10:30 p. m.

18th.—Light, drizzling rain continued from midnight till 10:35 a. m.; cloudy the remainder of the day, with a light sprinkle from 4:10 to 4:25 p. m.; slightly cooler, with low barometer, rising slowly after noon; brisk southeast winds during night becoming light toward noon; at 2 p. m. wind veered to northwest, increasing to brisk and decreasing suddenly to light at 8:30 p. m.; at 10 p. m. fresh southeast wind began.

Green Bay, Wis., 17th.—Thunderstorm; first heard, 3:55 p. m.; loudest, 4:30 p. m.; last, 5:15 p. m.; storm came from the southwest and moved toward the northeast; temperature before the storm, 66°; after, 66°; direction of the wind before the storm, northeast; after, northeast; light rain began 3:45 p. m., ended 5:30 p. m.; partly cloudy, cooler weather, rapidly falling barometer, fresh variable winds; distant sheet lightning observed in the north at 8:20 p. m.

18th.—Cloudy weather during morning; clear during afternoon; warmer; rising barometer; fresh westerly winds.

Milwaukee, Wis., 17th.—Ordered to hoist easterly information signal 4:30 p. m.; received at 5 p. m.; thunderstorm, only one peal of thunder was heard and that occurred at 5:10 p. m.; storm came from the south and moved toward the northeast; temperature before, 62°; after, 61°; direction of wind before, east; after, southeast; rain began at 5:10 p. m. and ended at 5:35 p. m.; amount, 0.02 inch; order to hoist southeast storm signals 10:15 p. m.; was received at 10:45 p. m.; brisk easterly winds to high westerly; maximum velocity, 25 miles southwest at 11:40 p. m.; rapidly falling barometer and much higher temperature during the evening and night.

18th.—Order to lower signals 10:30 a. m. was received at 10:55 a. m.; much lower barometer and slightly warmer; high westerly winds shifting to easterly and decreasing in force; maximum velocity, 26 miles southwest at 3:10 a. m.; dense fog set in at 5:30 p. m. and continued until 11:30 p. m., after which time it became light; it disappeared entirely about midnight.

Chicago, Ill., 17th.—Clear all day; warmer; variable winds; hoist easterly information signal at 4:30 p. m.; changed to storm southeast at 10 p. m.

18th.—Mostly clear in forenoon; continued warm, high westerly winds, increasing in force, maximum velocity 40 miles from the southwest; signals down at 10 a. m.

Grand Haven, Mich., 17th.—Dense fog continued through the night, lifting at 10 a. m.; fog deposit to the amount of .02 inch was recorded; barometer began to fall rapidly at midday with partly cloudy weather becoming cloudy and threatening in the evening, with a light thunderstorm; light sprinkling rain from 6:55 to 7:35 p. m.; first thunder heard 5:58 p. m.; loudest, 6:55; last, 7:25 p. m.; storm moved from west to east; temperature before storm, 79°; after, 72°; wind before storm, southwest; after, southeast; wind increased from the southeast during the night and veered to southwest at 11:15.

18th.—High southwesterly winds in the early morning diminishing toward daylight and veering to northwesterly; cloudy in the morning, followed by a dense fog from 9:30 to 11 a. m.; fog deposit, trace; clear in the afternoon and at night.

Alpena, Mich., 17th.—Light rain began at 7:30 p. m. ended at 8:35 p. m.; thunderstorm began at 10 p. m.; loudest, 11:35 p. m., and continued; storm moved from west to east; direction of wind before, southeast; during, southeast, east, northwest, north, and northeast; temperature before, 58°; heavy shower of rain began 10:50 p. m. and continued; hoist easterly information 4:30 p. m.; received 6 p. m.; hoist storm southeast 10:15 p. m.; received 11:25 p. m., gale began 11:50 p. m. and continued; very sudden and rapid changes in atmospheric pressure occurred between 9:30 p. m. and midnight, accompanied by decided rises and fall of the water in Thunder Bay and Thunder Bay River; from about 9:30 p. m. to about 10:30 p. m. the barometer fell from 29.17 to 29.01 when it rapidly rose to 29.22 apparently in about five minutes, and then fell to 29.[illegible]5 a little after 11.40 p. m.; at midnight it had fallen to 29.08 and was st[illegible] falling.

18th.—Thunderstorm ended 12:30 a. m.; direction of wind after, southeast and east; temperature after, 53°; rain ended during night; winds shifted to northwest at 10 a. m.; gale attained its height 12:20 a. m., 35 miles southeast; ended 1 a. m.; special observation 2:30 p. m. * * * Slightly warmer, cloudy, and threatening up to 4 p. m., when clouds began to break away; between 8:15 a. m. and 9:15 a. m. the water in Thunder Bay River fell about three feet; The barometer during this time was stationary; about 9:15 a. m. the water began to rise, and in a few minutes had about reached its normal level; at Puck's Mill work was suspended for about an hour on account of the low water.

Port Huron, Mich., 17th.—Slight change in temperature; light variable winds; dense fog began 1 a. m.; ended 7 a. m.; westerly information signal hoisted 5:35 p. m.

18th.—Thunderstorm; first heard, 1:12 a. m.; loudest, 2:19 a. m.; last, 3:55 a. m.; storm came from the west and moved toward the east; temperature before and after the storm unknown; direction of the wind before the storm, southeast; after, southeast; light rain began 1:38 a. m., with heavy rain from 1:50 a. m. till 3 a. m.; gale of 32 miles southwest at 2:08 a. m.; the thunder and lightning were almost continuous during the entire storm.

Detroit, Mich., 17th.—Dense fog prevailed from early morning until 8:10 a. m.; morning cool, but the day was quite warm; falling barometer with light to fresh westerly winds going to easterly at 2 p. m.; distant lightning was first seen at 8:27 p. m.; three peals of thunder were heard; first, 9:10 p. m.; last, 9:20 p. m.; light rain from 9:17 p. m. to 9:40 p. m.; storm moved from west to east; temperature before, 65°; after, 65°; wind direction before, northeast; after, southeast.

18th.—Falling barometer with much higher temperature; brisk to high westerly winds going to fresh northeasterly after 8 p. m.; a light shower fell from 3:25 a. m. to 3:50 a. m.; it was accompanied by a gale which began at 1:36 a. m., reaching a maximum of 32 miles southwest at 2:39 a. m., ending at 3:50 a. m.; a second gale began at 8:45 a. m., ending at 2:02 p. m.; maximum velocity 32 miles west at 9:49 a. m.; at 9:45 a. m. a westerly information signal was hoisted and was lowered at sunset; rising barometer during the evening and rapidly falling temperature; evening clear.

Toledo, Ohio, 17th.—Clear day; falling barometer; warmer; light to brisk west winds, becoming variable; thunderstorm moving from west to east, with very sharp and frequent lightning; first heard, 8:30; loudest, 9:15; last, 11:10 p. m.; temperature before, 73°; during, 67°; after, 73°; wind before, southeast; during, southeast, west, southwest; after, southwest; rain began 8:58; ended, 11:40 p. m.; amount, .28 inch.

18th.—Clear day and night, falling, followed by rising barometer; continued warm; brisk to high winds, southwest shifting to northwest; maximum velocity 29 miles northwest at 10 a. m.

Sandusky, Ohio, 17th.—Weather clear and slightly cooler, with light

to fresh westerly winds; light rain began 10:16 p. m., ended 11:10 p. m.; amount, .11 inch; thunderstorm; first heard, 10:20 p. m.; loudest, 11 p. m.; last, 11:06 p. m.; storm moved from northwest to southeast.

18th.—Weather clear and warmer; westerly winds, becoming high at 9:45 a. m., decreasing to light late in p. m.

Indianapolis, Ind., 17th.—Warm, clear in the forenoon; partly cloudy in the afternoon; near sunset, threatening clouds in the west; at 7 p. m. noted lightning southwest; heard first thunder at 7:07 p. m., loudest, 7:15 p. m., and last at 7:54 p. m.; light rain from 7:20 p. m. to 7:40 p. m.; frequent flashes of lightning followed by distant thunder; the storm moved from northwest to southeast; no change in temperature; wind, light south preceding; northwest during, and south after the storm; clear evening.

Columbus, Ohio, 17th.—Cloudy in the morning, clearing during the forenoon; a slight sprinkle of rain began and ended during the night of the 16th and 17th; rainfall 8 p. m. [16th] to 8 p. m. [17th], trace.

18th.—Clear weather and rapidly rising temperature in the morning; fresh to brisk southwesterly wind during the day, falling to light in the evening; thunderstorm; first heard at 3 a. m.; loudest, 3:20 a. m.; last, 4 a. m.; temperature before the storm, 68°; after, continued to rise; direction of the wind before the storm, south; after, southwest; light rain began and ended during the night of the 17th and 18th; rainfall, 8 p. m. to 8 p. m., 0.04 inch.

Cleveland, Ohio, 17th.—Slightly warmer, followed by slightly cooler; generally clear weather, followed at night by increasing cloudiness with a trace of rain during the night, and light rain beginning at 10:30 p. m. and continuing; slightly lower temperature; light to fresh south winds, veering to southeast, generally southwest, increasing in force after 11 p. m.

18th.—Northwest signals hoisted by local forecast official at 9:50 a. m.; following received at 11 a. m.: "Hoist southwest signals 10:20 a. m. at Cleveland, Erie, Buffalo, and on Lake Ontario; storm central over Lake Huron, moving east." Telegram calling for 1 p. m. special received at 12:52 p. m.; observation taken on time, filed 1:20 p. m.; much warmer and unusually close, muggy, generally clear weather; much lower barometer; high southeast winds veering to northeast, generally southwest, with storm velocity from 2:03 a. m. to 1:41 p. m.; a gale from 4:20 a. m. to 5:05 a. m., with a maximum of 40 miles southwest at 5:02 a. m., decreasing in force after 2 p. m.

Erie, Pa., 17th.—Partly cloudy, warm, and pleasant.

18th.—A thunderstorm raged from 1 to 3 a. m., accompanied by lightning and rain; during the storm the wind reached 28 miles from the west; the thunder claps were unusually loud and the lightning flashes terrific; it was a most severe storm and extended over a large portion of western Pennsylvania; horses were killed and trees blown down, but no loss of life reported. Amount of rainfall, .54 of an inch; cloudy and threatening, warm and depressing; clear at night.

Buffalo, N. Y., 17th.—Partly cloudy day, quite warm in daytime, with some threatening clouds at sunset; westerly winds fresh to brisk becoming northeast in evening.

18th.—Partly cloudy day, being cloudy with heavy rain in morning and light local rains during day, cooler; variable winds fresh and brisk at intervals when from the westward; thunderstorm moved from southwest to northeast; first thunder heard, 3:10 a. m.; loudest, 3:20 a. m.; and last, 4:15 a. m.; wind before, northeast; during, northeast-east; after, southeast; the temperature fell from 58° to 52°; up storm southwest signals at 9:15 by order of local forecast official, and order confirmed by Chief of Weather Bureau at 11:37 a. m., and down at 10:25 p. m.; no high winds during display, but threatening conditions on a. m. map demanded same.

Rochester, N. Y., 17th.—Very heavy dewfall in morning; measurement in gauge, 0.01 inch; mostly clear, slightly warmer, southwest to northwest fresh and brisk winds.

18th.—Light rain 1:15 to 1:25 a. m.; thunderstorm; first heard, 2:50; loudest, 3:20; last, 4:10 a. m.; moved from south to north; light rain 2:20 to 5:40 a. m.; temperature and wind direction before storm 63°, northwest; after, 56°, southeast; thunderstorm; first heard, 10:24; loudest, 10:32; last, 10:40 a. m.; moved from west to east; light rain 10:20 to 11:40 a. m.; temperature and wind direction before storm 56°, southeast; after, 59°, north; light rain 7:10 to 8:15 p. m.

Albany, N. Y., 17th.—Warmer, pleasant day; scattered clouds in the afternoon, principally cirro-cumulus, moving from the west; low percentage of humidity at the evening observation; character of day, 2, clear.

18th.—Light rain during night (17-18th) to 10:00 a. m.; 3:03 p. m. to 3:17 p. m. and 6:30 p. m. to 7:30 p. m; weather threatening, with considerable amount of rapidly-moving scud; special observations taken at 10:35 a. m. and 1:00 p. m.

New York, N. Y., 17th.—Light haze in morning; light fog from 7 p. m. to 9 p. m.; clear day.

18th.—Evidence of tornadic action was observed in the east of station between 9:10 a. m. and 9:20 a. m.; there was a bank of dark clouds in great confusion moving apparently from the south; distinct formation could not be fully observed on account of the dense fog at the time; beginning at 9:05 a. m. the barometer fell .2 inch in fifteen minutes; the wind shifted from southeast to south and increased from 8 to 48 miles an hour; the temperature fell about 3°; at 9:30 a. m. the wind backed to southeast then to northeast and to north; the barometer rose as quickly as it fell, making almost a perfect V on the barograph sheet; no damage was reported in this neighborhood; distant lightning observed in the east from 8 p. m. to 9 p. m.; light fog from 6 a. m. to 9 a. m.; dense fog from 9 a. m. to 10:10 a. m., then light from 10:10 a. m. to 5 p. m.; light rain began 7:25 a. m. and ended at 9:45 a. m.; light rain began 2:20 p. m.; ended 2:35 p. m.; southwest signals hoisted 10:35 a. m.; lowered 6:30 p. m.; partly cloudy day.

Philadelphia, Pa., 17th.—Partly cloudy and warmer; evening clear.

18th.—Light fog from about 4 a. m. to 9:30 a. m.; morning cloudy; light rain began 7:10 a. m., increasing to brisk shower after 8 a. m., and ending 9:50 a. m.; marked barometric fluctuations between 9 and 10 a. m.; barometer fell .15 inch in about forty-five minutes, and then rose sharply .05, followed by a very slight and gradual fall; the wind increased to 33 miles for a short time just before 10 a. m., and afterwards continued very brisk all day; special observation taken at 10:10 a. m.; day mostly cloudy with sunshine during middle portion. * * * Evening clear until about 10 p. m. when the sky clouded over for a short time with a sprinkle of rain at 10:06 p. m.; thunderstorm; first thunder heard at 10:06 p. m., loudest, 10:10, and last heard 10:20 p. m.; the storm came from the west and moved toward the east; temperature before storm, 75°; after, 74°; direction of wind before, southwest; after, southwest.

Harrisburg, Pa., 17th.—Day warmer and cloudy throughout; light showers at intervals; during forenoon light westerly winds prevailed.

18th.—Day opened with thunderstorm; first thunder, 7 a. m.; loudest, 7:40 a. m.; last heard, 7:15 p. m.; moved from west to southeast; temperature before, 63°; after, 80°; wind before, west; after, south; no hail; clearing and warmer during afternoon; distant lightning during evening.

Baltimore, Md., 18th.—Cloudy, with light fog in the early morning; light rain began at 8:20 a. m., followed by a thunderstorm; first heard, 9:15 a. m.; loudest, 9:40 a. m.; last, 11:10 a. m.; storm came from the northwest and moved toward the southeast; temperature before the storm, 72°; after, 69°; rain ended at 11 a. m., followed by partly cloudy and clear weather; total rainfall for day, 0.25 inch; slightly warmer; light, brisk, and fresh southwest winds.

Washington, D. C., 18th.—Partly cloudy; thunderstorm; first thunder, 9:40 a. m.; loudest, 10 a. m.; last, 10:55 a. m; storm moved from north to south; temperature before, 73°; after, 67°; direction of wind before, south; after, south; wind, 24 miles from north during storm; rain, 8:40 a. m. to 11:20 a. m.; cleared at noon; cloudy and partly cloudy during the evening; lightning northwest to north; clearing at 10 a. m.

New Haven, Conn., 17th.—Clear until 1:20 p. m.; partly cloudy remainder of the day; much clearer.

18th.—Cloudy day; light fog prevailed from 9:20 a. m. to 5:40 p. m.; light rain from 7:10 a. m. to 10:05 a. m., and from 9:22 p. m. to 9:27 p. m.

New London, Conn., 17th.—Clear and pleasant, slightly warmer; light, westerly winds.

18th.—Cloudy and threatening until 7:30 p. m., when it became clear and continued remainder of day; rain began 8:06 a. m. and ended 10:41 a. m.; began again 6:06 p. m. and ended 6:32 p. m.; amount for day, 0.17 inch; light, variable winds.

Block Island, R. I., 17th.—Clear and pleasant, decreasing pressure, fresh, southwest winds.

18th.—Slightly warmer; light rain began at 10:10 a. m. and ended at 11:15 a. m.; light, variable winds.

Nantucket, Mass., 17th.—Slowly falling barometer, rising temperature; light, westerly winds; light rain began and ended during night; amount, 0.01 inch; dense fog set in at 7 p. m.

18th.—Cloudy weather; light rain began 10:10 a. m.; southwest signal received 11:35 a. m.; rain ended 2:35 p. m.; amount, 0.06; gentle, becoming fresh, southeast winds shifting to northwest in evening; barometer fell rapidly in late a. m.

Boston, Mass., 17th.—Light clouds gathered before noon, at which hour a large, well-defined solar halo became visible; the clouds passed away at sunset, but returned shortly after the evening observation; the feature was the marked increase in temperature, the latter advancing 16° above the highest figure of yesterday, making the day seem very warm in contrast; west to southwest winds, brisk in the afternoon.

18th.—Threatening clouds in the early part of the morning turned to a light, drizzling rain which lasted till about 1 p. m., with cloudy skies throughout the remainder of the day; the prevailing north to east winds brought a low temperature, and the air was chilly and disagreeable; southwest signals ordered on Newport section in the morning, and information signals at Boston and section; special observations taken at 10:40 a. m. and 1 p. m.

LOCAL ATMOSPHERIC DISTURBANCES.

By A. J. HENRY.

In addition to the local thunderstorms, tornadoes, and hailstorms and such local phenomena as chinook winds, and diurnal land and sea breezes, there are still other disturbances less conspicuous to the eye and which might be thought to be purely local phenomena if we had not records from enough stations to show that they have a very general aspect. The

preceding paper shows that so-called barometric waves sweep over the country in connection with thunderstorms. May they not also occur without thunderstorms? Such a case may be that of June 20, 1898, when the wave-like oscillations of the barometer at Williston, North Dakota, between 8 p. m. and midnight, were very remarkable and were repeated on the 22d, between 2 p. m. and 9 p. m., and again on the 23d between 4 p. m. and 8 p. m., although with diminished intensity. Notable disturbances are also found on nearly the same dates at the neighboring stations, Miles City, Mont., and Bismarck, N. Dak., but are barely visible on the barogram for Moorhead. (See Chart XII*b*, on which the barograms are reproduced.)

The general weather maps of 8 p. m. June 20, and 8 a. m. June 21, show that an area of low pressure, with southeast winds, was passing eastward over this region of the country, followed by high pressure with northwest winds.

The daily journals of the stations are as follows:

Williston, N. Dak., June 20, 1898.—Clear weather with light to fresh southeast winds; thunderstorm began at 8:50 p. m., ended during night.

June 22, 1898.—Partly cloudy; rain began and ended during night of 21st; began again at 9:30 a. m.; ended 10:20 a. m.; total, 0.12 inch; light northwest to southeast winds.

June 23, 1898.—Cloudy; rain began and ended during night; began again 8:30 to 9:25 a. m., 10:20 to 10:40 a. m.; began 5 p. m. and continued; total, 1.11 inch; wind fresh from the north.

Miles City, Mont.—The station agent in charge of this station does not keep a daily journal, but he has entered the word "thunderstorm" against the 8 p. m. observation of the 20th, thus indicating that such a storm was in progress at that time.

Bismarck, N. Dak., June 20, 1898.—Continued hot weather; maximum temperature, 95°, minimum, 70°; barometer falling steadily and slowly; temperature above 90° most of the afternoon, and only for a high, southerly wind the heat would have been oppressive; but an occasional cloud to be seen during the day, and there was none at all just before sunset, but soon after a heavy bank of clouds appeared in the southwest horizon and rose steadily, accompanied by almost incessant lightning, followed by a thunderstorm; first thunder heard at 11:48 p. m. and continued; maximum wind velocity, 30 miles.

June 21, 1898.—Thunderstorm continued; loudest thunder heard at 12:53 a. m.; rain began at 12:15 a. m. and ended during night, being heavy for a short time after it began. The day was warm, but not so warm as yesterday, with a light, southerly wind shifting to northwest, and slight changes in barometer; the wind attained a maximum velocity of 34 miles from the southwest soon after midnight; the rainfall during the thunderstorm amounted to 0.45 inch; lightning in the eastern horizon began early in the evening and continued.

June 22, 1898.—Heavy thunderstorm began during night, no data; rain began during night, and ended at 8:10 a. m., followed by cloudy and threatening weather and another thunderstorm; first thunder heard at 12:14 p. m.; loudest at 12:16 p. m.; storm came from the southeast and moved toward the north; temperature before the storm, 76°; after, 78°; direction of wind before the storm, east; after, southeast; no hail nor maximum wind velocity; light rain began at 12:20 and ended at 12:36 p. m.; amount, 0.02. The day was partly cloudy and threatening for the greater portion of the time, with slightly lower temperature and stationary barometer, and fresh, generally easterly winds; lightning in the eastern horizon in the early evening.

Havre, Mont.—The barogram shows no disturbances in pressure on the 20th corresponding to those observed at Williston. It does show, however, marked oscillations of the barometer in connection with a thunderstom twenty-four hours earlier. The observer's journal on the 20th follows:

June 20, 1898.—Cloudy at 11:00 a. m.; rain began at 11:59 a. m. and ended at 5:10 p. m.; clearing at 5:30 p. m.; clear at 6:00 p. m.; partly cloudy day and cooler.

The reports of voluntary observers between Williston and Bismarck do not show, as a rule, the beginnings and endings of rainfall or thunderstorm and it is, therefore, impossible to trace the Williston storm southeastward toward Bismarck, or, in fact, in any direction, so far as could be discovered. This is perhaps not surprising in view of the paucity of observing stations in the vicinity of Williston, the nearest one being about 50 miles distant.

Moorhead, Minn. (about 200 miles due east of Bismarck), June 20, 1898.—Partly cloudy in the morning soon clearing; the day was very warm, with fresh to brisk southeast wind; maximum temperature, 90°.

June 21, 1898.—The day was partly cloudy, with fresh to brisk and high wind; maximum, 34, southeast at 12:45 p. m.; thunder at 11:20 p. m.; storm reported on 22d.

June 22, 1898.—Thunderstorm; thunder first heard at 11:20 p. m. of the 21st; loudest at 12:20 a. m.; last about 3:00 a. m.; the storm came from the southwest and moved toward the northeast; temperature before the storm, 71°; after, 63°; direction of wind before the storm, southeast; after, southeast; rain began 12:05 a. m.; ended during night, amount at 8:00 a. m., 0.10 inch; high wind in the early morning, maximum 35 southeast at 12:45 a. m.; wind continued brisk southeast. Thunderstorm (2d); thunder first heard, 3:55 p. m.; loudest, 4:40 p. m.; last, 5:10 p. m.; the storm came from the southeast and moved toward the northeast; temperature before the storm, 82°; after, 68°; direction of wind before the storm, southeast; after, southeast; no hail at station; rain began 4:40 p. m., ending 5:10 p. m.; total 24-hour rainfall, 0.14 inch.

Summarizing the foregoing by dates, we find that on the 20th thunderstorms occurred at Williston (latitude, 48° 9′ N.; longitude, 103° 35′ W.), Miles City (latitude, 46° 25′ N.; longitude, 105° 49′ W.), and Bismarck (latitude, 46° 47′ N.; longitude, 100° 38′ W.), beginning at 8:50, 7:55, and 11:48 p. m., respectively. The curves of each barogram, while differing among themselves in their sinuosities, all show a more or less marked disturbance of pressure about the time the thunderstorms began. The fact that the thunderstorm at Bismarck did not begin until about four hours after the one at Miles City suggests that after all there may have been a continuous line of thunderstorm development between the two places.

21st.—The thunderstorm of the 21st continued at Bismarck, but there were no thunderstorms or perturbations in the barograms at the remaining stations, if we except two small drops in the Moorhead curve about ten and fifteen hours after the principal drop at Bismarck.

22d.—The Williston observer reports that a rainstorm began during the night; the Bismarck observer, a heavy thunderstorm. Both barograms show marked oscillations of pressure beginning at 1 a. m. at Williston, and shortly before 2 a. m. at Bismarck. As the distance between the two stations is about 160 miles it seems evident that in this case there was no actual propagation of an atmospheric wave from the one station to the other. The Moorhead barogram shows a pressure oscillation very shortly before 11 p. m. of the 21st, and the observer reports a thunderstorm at 11:20 p. m., continuing until 3 a. m. of the 22d. Thunderstorms were, therefore, apparently in progress simultaneously at two of the stations and a rainstorm at the third.

ARE OUR WINTERS CHANGING?

By ALFRED J. HENRY.

The frequency and severity of the cold waves that have visited the southern portion of the United States in late years, and the fact that the present winter season began much earlier than usual have led a number of people to make inquiry as to what are the reasonable expectations for the future? Is it probable that a more or less permanent change in the character of the winters has taken place? This problem is important since it involves a possible readjustment of present economic conditions. It is not new, nor is it any nearer a clear and definite solution than it was fifty years ago. According to the trend of the best thought of to-day the climate is not perceptibly changing. The mean temperatures obtained by the earliest instrumental observations, both in this country and abroad, show no differences greater than might reasonably be due to the character of the instruments used and their environment. The yearly means for a single station do not show a steady increase in heat culminating in a period of high temperature and then gradually receding

toward a period of diminished heat, but rather an irregularity in the distribution of warm and cold years that suggests at once the absence of any system of compensation or any gradual progression from one extreme to the other. Studies of annual means, when broadened to include those from a number of stations scattered over the globe are not devoid of interest, though perhaps they have not as yet yielded results of immediate practical importance.

For the States bordering the Gulf and South Atlantic coasts continuous instrumental records of the temperature previous to 1870 are lacking, although a number of broken series are available. The degree of cold experienced before that date is naturally a matter of considerable uncertainty, and while we may form a general idea of the relative severity of the winters, we are prevented from making as full an examination of the matter as its importance demands.

Taking Florida as a concrete illustration, we find that at least four very disastrous freezes have occurred within the one hundred years ending with 1898. We are inclined to the opinion that the first one, viz, that of 1835, was the most severe. The State then escaped further visitation for a period of fifty-one years, or to January, 1886. The next period of immunity was comparatively brief, viz, seven years, or to December, 1894. Within two months of the last-named date, a second disastrous freeze occurred and there have been a number of dangerously low temperatures since.

The impression that the climate is changing is partly due to the fact that in recent times an account of every severe frost and freeze that occurs in the South is sent broadcast to all parts of the country, whereas, during earlier times no record was preserved except of the very severe freezes. This very lack of information respecting the earlier minor freezes prevents us in a measure from asserting in a more positive manner a rule of climate that appears to be common to all parts of the United States, viz, that periods of great refrigeration generally extend over several years. In support of this assertion, as affecting Florida, reference is made to the fact that the great freeze of 1835 was preceded by two severe winters, 1830–31 and 1831–32, and was immediately followed by a winter of more than average severity, 1836. The freeze of 1886 was preceded by a cold spell in January, 1884 (minimum at Jacksonville 21°), and the temperature fell to 22° at Jacksonville in January of 1887. The two freezes of the winter of 1894–95 were preceded by a cold wave in 1893, in which temperature fell to 24° at Jacksonville. All of this would seem to indicate, as above stated, that cold years are likely to be followed by years of similar character separated by one or more warm years, the complete cycle of events extending over from four to seven years; but we should not forget that this conclusion is not based on sufficient data to establish it firmly.

OBSERVATIONS AT RIVAS, NICARAGUA.

The records contributed for many years by Dr. Earl Flint, at Rivas, Nicaragua, include barometric readings. His present station is at 11° 26′ N., 85° 47′ W. The observations at 7:17 a.m., local time are simultaneous with Greenwich 1 p.m. The altitude of his barometer is 36 meters above sea level, but until the barometer has been compared with a standard it seems hardly necessary to publish the daily readings. The wind force is recorded on the Beaufort scale, 0–12. When cloudiness is less than $\frac{1}{10}$, the letter "F," or "Few," is recorded.

This station is situated on the western shore of Lake Nicaragua, not far from the eastern end of the western division of the Nicaragua Canal. The volcano Ometepe, on an island in Lake Nicaragua, is about 10 miles northeast of the station. Mr. Flint's records occasionally mention the presence of clouds in the early morning on the summit of this mountain.

Observations at Rivas, Nicaragua, November, 1898.

OBSERVATIONS AT 7:17 A. M. LOCAL (8 A. M. EASTERN STANDARD) TIME.

Date.	Temperature.		Wind.		Upper clouds.			Lower clouds.			Daily rainfall.
	Air.	Dew-point.	Direction.	Force.	Kind.	Amount.	Direction from.	Kind.	Amount.	Direction from.	
	°	°									
1	72	68	nw.	0	cs.-ck.	10	se.				0.00
2	71	68	nw.	0	ck.	6	ne.				0.00
3	72	69	nw.	0	cs.	10	se.				0.00
4	74	71	se.	0				k.	10	se.	0.06
5	77	73	se.	1				ks.	Few	se.	0.00
6	78	74	ne.	1	cs.	1	ne.				0.00
7	76	73	ne.	1	cs.	3	se.				0.10
8	77	72	ne.	1				k.	Few	ne.	2.76
9	77	74	ne.	1				k.	10	ne.	0.04
10	77	72	ne.	2	cs.	5	se.	k.	5	no.	0.04
11	77	74	ne.	1	c.	2	sw.	k.	2	ne.	1.23
12	77	75	ne.	0	cs.	8	e.	k.	8	ne.	1.77
13	75	74	ne.	2				ks.	10	ne.	0.69
14	76	72	ne.	1	c.	5	se.	k.	5	ne.	0.00
15	76	74	ne.	2				ks.	10	ne.	0.37
16	76.5	71	ne.	1	ck.	2	ene.				0.33
17	76	73	ne.	3				ks.	9	ne.	0.00
18	76	73	ne.	0	cs.	1	ne.				0.00
19	76	73	ne.	2	cs.	3	ne.				0.13
20	76	70	ne.	2				ks.	10	ne.	0.00
21	76	73	ne.	2				k.	Few	ne.	0.00
22	76	73	ne.	2				k.	2	ne.	0.00
23	76	71	ne.	1				k.	7	ne.	0.00
24	76	73	ne.	1				k.	Few	ne.	0.00
25	76	72	ne.	2	c.	Few	se.	ks.	Few	ne.	0.00
26	76.5	73	ne.	1				k.	Few	ne.	0.00
27	78	74	ne.	2				ks.	10	ne.	0.86
28	77	73	ne.	1				ks.	10	ne.	0.31
29	77	73	ne.	2	cs.	Few	ne.	k.	Few	ne.	0.00
30	76	71	ne.	3	cs.	Few	ne.	ks.	Few	ne.	0.00
Sums											8.19
Means	75.9										

Rainfall nearly twice the normal for November.

OBSERVATIONS AT 8:43 P. M. SEVENTY-FIFTH (8 P. M. LOCAL) TIME.

Date.	Temperature.		Wind.		Upper clouds.			Lower clouds.		
	Air.	Dew-point.	Direction.	Force.	Kind.	Amount.	Direction from.	Kind.	Amount.	Direction from.
	°	°								
1	75	72	w.	0.5	cs.-ck.	10	nw. se.			
2	76	73	nw.	0	cs.	10	nw.			
3	77	73	nw.	0	c. ck.	10	sw. ne.			
4	80	76	se.	1	c., ck.	6	se.			
5	79	75	se.	0				ks.	10	
6	81	77	se.	1	ck.	10	se.			
7	80	76	se.	2	cs.	10	se.			
8	78	77	se.	0				k.	10	
9	78	75	se.	1				k.	10	
10	78	75	e.	0				k.	10	se.
11	77	74	se.	0				k.	10	se.
12	77	76	ne.	1				n.	10	ne.
13	77	74	ne.	1				n.	10	
14	78	74	ne.	1		0			0	
15	78	74	ne.	2				ks.	10	ne.
16	77	73	ne.	2				ks.	5	ne.
17	77	74	ne.	0				ks.	10	ne.
18	78	74	ne.	0				ks.	10	ne.
19	78	72	e.	1	ck.	8	e.			
20	77	73	ne.	2	c.	Few	ne.			
21	79	73	e.	1	cs.	Few	e.			
22	78.5	75	e.	0		0			0	
23	80	74	e.	0		0			0	
24	78	73	ne.	1				k.	6	ne.
25	79	75	ne.	1				k.	9	ne.
26	79.5	75	e.	1				k.	10	e.
27	77	74	se.	1				k.	10	se.
28	76	73	e.	0	c.	7	e.			
29	78	74	ne.	2	cs.	8	ene.			
30	78	72	ne.	2				ks.	9	ne.
Means	78.3									

MEXICAN CLIMATOLOGICAL DATA.

Through the kind cooperation of Señor Mariano Bárcena, Director, and Señor José Zendejas, vice-director, of the Central Meteorologico-Magnetic Observatory, the monthly summaries

of Mexican data are now communicated in manuscript, in advance of their publication in the *Boletin Mensual;* an abstract translated into English measures is here given in continuation of the similar tables published in the MONTHLY WEATHER REVIEW since 1896. The barometric means have not been reduced to standard gravity, but this correction will be given at some future date when the pressures are published on our Chart IV.

Mexican data for November, 1898.

Stations.	Altitude.	Mean barometer.	Temperature. Max.	Temperature. Min.	Temperature. Mean.	Relative humidity.	Precipitation.	Prevailing direction. Wind.	Prevailing direction. Cloud.
	Feet.	*Inch.*	° *F.*	° *F.*	° *F.*	%	*Inch.*		
Leon (Guanajuato)...	5,934	24.30	76.3	34.9	60.6	58	1.14	nnw.	sw.
Linares (New Leon) .	1,188	28.78	83.3	42.8	61.5	73	1.79	n.	n.
Mazatlan	25	29.90	85.1	63.7	70.5	72	0.57	nw.	sw.
Merida (Yucatan)....	50	29.91	95.4	61.7	76.8	83	4.49	e.	e.
Mexico (Obs. Cent.)..	7,472	23.06	72.5	36.5	57.2	67	1.23	nw.	sw.
Morelia (Seminario)..	6,401	23.97	74.1	41.4	58.8	75	0.46	sw.	sw.
Oaxaca	5,164	25.07	83.7	42.8	67.1	62	0.08	nw.	ne.
Puebla (Col. Cat.) ...	7,112	23.36	77.0	32.5	59.7	75	3.48	ene.	e.
Tuxpan (Vera Cruz).	....	30.26	89.6	52.3	70.7	82	1.44	nw.	s.
Zacatecas	8,015	22.51	77.4	34.2	55.8	59	0.56	sw.	e.
Zapotlan	5,078	....	78.3	49.3	61.9	79	0.61	se.	sw.
DECEMBER, 1898.									
	Feet.	*Inch.*	° *F.*	° *F.*	° *F.*	%	*Inch.*		
Durango (Seminario)	6,043	......	73.4	32.0	......	......	0.18	....	w.
Leon (Guanajuato)..	5,934	24.33	73.8	30.9	56.3	49	T.	ssw.	sw.
Merida (Yucatan)....	50	30.02	95.2	56.8	73.6	79	6.21	e	n.
Mexico (Obs. Cent.)..	7,472	23.08	70.3	36.9	54.5	60	0.05	nw.	sw.
Morelia (Seminario)..	6,401	24.00	73.0	39.0	55.8	62	0.07	ssw.	w.
Oxaca	5,164	25.12	82.0	38.1	63.0	57	1.41	nw.	sw.
Pueblo (Col. Cat.)....	7,112	23.39	73.4	32.9	56.3	70	0.39	ene.	se., sse.
San Isidro	....	....	67.1	50.9	....	....	0.13	w.	....
Tuxpan (Vera Cruz).	......	30.21	97.2	46.4	63.3	81	T.	nw.	s.
Zapotlan (Seminario)	5,078	25.14	77.4	41.7	61.5	77	0.01	sse.	sw.

METEOROLOGICAL OBSERVATIONS NEAR CIRCLE CITY, ALASKA.

By J. O. HOLT.

Mr. J. O. Holt, formerly a voluntary observer of the Weather Bureau, has kindly furnished a copy of meteorological observations made by him in the Birch Creek Mining District, Alaska, from December, 1896, to June, 1898, inclusive. Mr. Holt's remarks in connection with the observations and his sojourn in Alaska are as follows:

These observations were taken about 75 miles south of Circle City in the mountains at headwaters of Birch Creek. I consider them of value for this reason, that during the colder parts of winter the thermometer stands from 15° to 20° *higher* here in the mountains than down on the flats, at Circle City, or at any point along the Yukon River. But in summer the thermometer stands highest in the lowlands. These are facts that every old timer has noticed, but I have never heard a satisfactory explanation for them. Of course our coldest weather is perfectly quiet, and as there is much more wind in the gulches than on the flats that is certainly one of the factors. I have seen the temperature run up 30° in 3 hours at the beginning of a wind, and run down as quickly when the wind stopped blowing.

During March, 1897, when the temperature was —42° at the mines it was —65° at Circle City, down on the Yukon, 75 miles away. The divergence became less as the temperature rose toward zero.

The fact that interior Alaska is as dry as eastern Washington is hard to believe even by one who has spent years in the country. For eight months everything is buried under snow, and for the other four the country is covered with lakes, sloughs, swamps and soggy moss reaching to the very mountain tops, yet the annual rainfall is only 12 or 13 inches.

The two winters which these records cover were, from all reports, very mild ones for this locality.

Observations in the interior of Alaska during the short summer have an important bearing upon the agricultural possibilities of that region. Besides the observations made by Mr. Holt only two other series are known to extend throughout the summer season, viz, that of the United States Coast Survey at Camp Davidson (see MONTHLY WEATHER REVIEW June, 1897, p. 248), and that by Mr. Wm. Ogilvie, Land Surveyor of the Dominion of Canada (see the Scottish Geographical Magazine, Vol. XIV, No. 7). A summary of Mr. Ogilvie's observations appears in the MONTHLY WEATHER REVIEW of June, 1898, pp. 253–254.

It is quite possible that the mountainous country, where the observations above referred to were made, is not adapted to the purposes of agriculture. The minimum temperatures in summer, however, give us some idea of the conditions which must prevail at lower altitudes and nearer the coast. Mr. Holt's observations have been summarized in the Division of Records and Meteorological Data, and the results are given in the table following.

In June, 1897, the temperature fell to 40° or below on three days; in July on but one day; in August on fifteen days, and the minimum temperature was 40° or below continuously from the 18th of August to the 31st. In June, 1898, the temperature fell to 40° or below on four days. At Camp Davidson, the site occupied by the United States Coast Survey party of 1889–90, the temperature in June fell to 40° or below on twelve days, and the minimum of the month was 29.8° on June 27; in July the temperature fell to 40° or below on five days; in August on eleven days.

It would seem from the above that frost and freezing temperatures are to be expected in the latter part of August, and that there is indeed a possibility of frost in every month of the summer season.

Observations at Circle City (near), Alaska.

Latitude, 65° 30′ north; longitude, 144° — west.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
MEAN MAXIMUM TEMPERATURE.												
1896.......	......	......	......	....	......	......	......	......	......	......	......	8.6[a]
1897.......	—4.3	— 3.5	3.5	27.6	43.3	65.5	63.3	56.7	33.3	19.3	6.1	5.0
1898.......	—0.2	— 7.6	25.4	34.0	46.2	67.0	......	......	......	......	......	......
MEAN MINIMUM TEMPERATURE.												
1896.......	......	......	......	......	......	......	......	......	......	......	......	—14.6[a]
1897.......	—9.3	— 9.1	—13.2	13.1	28.7	50.4	50.0	40.6	22.8	6.4	—0.3	— 1.9
1898.......	—6.2	—14.8	13.9	18.4	30.4	49.0	......	......	......	......	......	......
ABSOLUTE MAXIMUM TEMPERATURE.												
1896.......	......	......	......	......	......	......	......	......	......	......	......	9[g]
1897.......	22	28	29	38	59	84	82	70	52	38	28	28
1898.......	28	24	38	48	78	84	......	......	......	......	......	......
ABSOLUTE MINIMUM TEMPERATURE.												
1896......	......	......	......	......	......	......	......	......	......	......	......	—34[g]
1867.......	—31	—25	—42	— 8	8	34	40	26	2	—12	—21	—18
1898.......	—31	—38	0	4	6	32	......	......	......	......	......	......
MEAN TEMPERATURE.												
1896.......	......	......	......	......	......	......	......	......	......	......	......	—11.6[a]
1897.......	—6.8[b]	—6.3	—4.8	20.4[c]	36.0	58.0[d]	56.6	48.6	28.0[e]	12.8	2.9	1.6[f]
1898.	—3.2	—11.2	19.6	26.2[g]	38.3	58.0	......	......	......	......	......	......
TOTAL RAIN AND MELTED SNOW.												
1897.......	1.65	0.10	[h]	1.10	1.45	0.70[i]	2.30	1.65	1.50	1.15	0.10	0.40
1898.......	0.20	0.40	1.60	0.75	0.75	0.29	......	......	......	......	......	......
TOTAL SNOWFALL.												
1896.......	16.5	1.0	....	11.0	12.5	0.00[k]	0.00	0.00	15.5	11.5	1.0	4.0
1897.......	2.0	1.0	16.0	7.5	2.5	0.00	......	......	......	......	......	......

[a] Fourteen days missing. [b] Great irregularity in range caused by starting or stopping of wind. [c] Mean temperature above freezing April 11. [d] Flowers blooming in profusion. [e] On 19th the temperature fell below freezing and remained there. [f] South wind always raises temperature, which falls when wind stops blowing. [g] General average rose above freezing for the first time April 13. [h] Precipitation was something less than one inch during month. [i] Considerable thunder but little rain. [k] Snow all gone by 10th.

WHAT A WEATHER OBSERVER SHOULD KNOW.

By N. R. TAYLOR, Observer Weather Bureau.

What must one know in order to become an observer in the United States Weather Bureau is a question that perhaps every man in this service has been called upon to answer times without number and if this article will give an adequate reply to the query, the writer will feel that his labor has not been thrown away.

The Civil Service Commission will also answer the question from their standpoint and tell the would-be weather prophet that in addition to a fair knowledge of the three "R's" he must know something of physics, geography, history, etc., and a great deal of meteorology, in order to secure their diploma of eligibility, but they can not tell, if their graduate is fortunate enough to receive his appointment, whether or not he will be a success.

A Weather Bureau man serving on station, whether he ranks as local forecast official, section director, observer, or revels in the three combined, to be a credit to the service, must be a man of education and training, and in addition to being, like Benjamin Franklin, a "philosopher, philanthropist and printer," should be a statistician, a geologist and a farmer; he must be able to prophesy of weather events to come and keep an accurate and comprehensive record of those past. He should be an electrician too; and an astronomer, unaided by any stargazing paraphernalia with which to sweep the heavens for lost comets.

That a weather observer should be a philosopher is almost too evident to discuss, as the science he represents is based on natural laws, many of which yet remain to be discovered, and the Weather Bureau of to-day with its remarkable achievements would not be in existence had not thinking men turned into account their knowledge of physics and applied it to the various atmospheric changes, until now the art of observing, forecasting, and tabulating weather conditions follows in importance close on the heels of the science from which it sprung.

It would not seem that philanthropy could enter into an occupation where cold-blooded calculations, facts and figures, play so important a part, but it should be remembered that an observer is at all times ready to brave every climate for the benefit of mankind and science; that his stations are scattered from the edge of the arctic circle in Alaska to the tropical jungles of South America; that he should be equally competent to foretell a change of weather to the weary gold seeker on the Yukon, herald an approaching cold wave from his bleak post in the far Northwest, or recognize the incipient symptoms of a West India hurricane as it coils for a spring at our commerce in southern waters.

Although a printer is furnished to Weather Bureau stations whose publications are printed, yet there will often arise occasions when a knowledge of type setting would greatly increase the value of an observer and prevent many a temporary break in the records of his station.

Statistics play no small part in a weather observer's work, and in order to compile useful data from which to deduce important facts in the future, it is obvious that much depends upon records being intelligently as well as accurately kept. It is a popular belief among some that one day is the exact counterpart of some other; that back in some period of the world's history the atmosphere varied in pressure, the temperature rose and fell, the winds backed and veered and the clouds formed, changed their shape and melted away, each in their turn, with unvarying regularity, again and again, to be repeated in regular cycles as the unceasing mill of time grinds out the years. While many facts tend to prove the fallacy of this theory, climatic records do not yet extend far enough back to positively controvert it, and it rests with the weather observer in the future, with his accumulated data of centuries, to establish the truth.

The relation between climates and crops is so close that a knowledge of the latter is indispensable to the proper performance of an observer's duties, and he should also be geologist enough to study the soil in his State or Territory with a view to determine its special adaptability to the various products. The success of the pioneer, the enjoyment of the tourist, and the recovery of the health seeker depend not only upon the climate of a place but upon its productions as well. The up-to-date farmer is no longer a creature of mere brawn and muscle; he relies as much upon the science of his occupation for success as he does upon the sweat of his brow, and the official who represents the Climate and Crop Service of the Weather Bureau should be alive to all his needs and an unfailing source for any information he may require.

Many of the most important records of the Weather Bureau are now made by self-registering machines which do their work with the aid of electric contacts, and while it is not necessary to be an Edison or a Tesla in order to understand the few principles of electricity involved, an observer should, at least, be master enough of the science of this subtile fluid to account for and remedy any defects in the workings of his instruments.

While a knowledge of astronomy was mentioned as one of the requirements of a weather observer, it must not be supposed that this science is used in connection with meteorology in forecasting the weather, or that an observer should be able to chart the constellations of the heavens, figure out the time for the next transit of Venus, or measure the parallax of Sirius. There are times, however, when a knowledge of some of its elements is imperative, for he should know how to use those imaginary points and circles in the celestial sphere in order to intelligently describe any phenomena that might have a bearing upon his work. There is the aurora to be described in all its details, from the first arch of dawn-like light until it bursts forth in all its variegated splendor; there are halos of endless variety, both of sun and moon, to be noted; there are myriads of meteors that wander from their orbits among the stars and shoot into our atmosphere, leaving a fleeting but luminous track which the quick eye of the observer should measure; and there are many other wonderful things constantly occurring, among and above the clouds, a record of which would make useful data for future investigation.

There have been many marked improvements made in the Weather Bureau during its comparatively short existence; its methods are more scientific, its aims are broader, its results more satisfactory; and, in proportion to its progress, its need for intelligent observers is becoming more urgent. It is the dream of the Chief of the Weather Bureau to some day strike the keynote to absolute accuracy in weather forecasting, and all his subordinates should indulge in the same hope and work for the same conclusion. To this end, no stone that could hide the precious secret should be left unturned, no experiment, however simple, be untried, and no theory be untested.

OBSERVATIONS AT HONOLULU.

Through the kind cooperation of Mr. Curtis J. Lyons, Meteorologist to the Government Survey, the monthly report of meteorological conditions at Honolulu is now made nearly in accordance with the new form, No. 1040, and the arrangement of the columns, therefore, differs from those previously published.

Meteorological observations at Honolulu.

NOVEMBER, 1898.

The station is at 21° 18′ N., 157° 50′ W.; altitude 50 feet.

Pressure is corrected for temperature and reduced to sea level, and the gravity correction, —0.06, has been applied.

The average direction and force of the wind and the average cloudiness for the whole day are given unless they have varied more than usual, in which case the

extremes are given. The scale of wind force is 0 to 10. Two directions of wind, or values of wind force, connected by a dash, indicate change from one to the other.

The rainfall for twenty-four hours is now given as measured at 1 p. m. Greenwich time on the respective dates.

The rain gauge, 8 inches in diameter, is 1 foot above ground. Thermometer, 9 feet above ground. Ground is 50 feet above sea level.

Date.	Pressure at sea level.	Temperature.		During twenty-four hours preceding 1 p. m. Greenwich time.									
				Temperature.		Means.		Wind.		Total rainfall.	Average cloudiness.	Sea-level pressures.	
		Dry bulb.	Wet bulb.	Maximum.	Minimum.	Dew-point.	Relative humidity.	Prevailing direction.	Maximum force.			Maximum.	Minimum.
	*	†	†			‡	‡		§				
1	30.08	74	66.5	80	73	63.7	66	nne.	5	0.04	5	30.10	30.03
2	30.04	74	67	80	74	63.7	65	ne.	6	0.08	4	30.08	29.97
3	29.99	74	67	80	73	63.5	64	nne.	6	0.00	3	30.08	29.98
4	29.98	75	68	80	74	64.7	67	ne.	5	0.00	4	30.04	29.94
5	29.98	74	67	81	74	62.7	63	ne.	6	0.01	5	30.03	29.95
6	29.93	75	68	79	73	63.2	65	nne.	4	0.01	7	30.03	29.91
7	29.93	73	67	78	72	64.5	66	ne.	4	0.01	10	29.98	29.89
8	29.96	73	67	82	71	64.7	65	ne.	3	0.08	4	30.02	29.92
9	29.97	72	68	79	70	64.2	69	nne.	6	0.51	5	30.01	29.92
01	29.94	74	68	80	68	64.0	68	ne.	4	0.10	5	30.01	29.92
11	29.90	70	67	80	71	64.7	70	ne.	3	0.01	5	29.97	29.89
12	29.90	66	65	80	70	64.2	77	nne.	3	0.00	2	29.95	29.85
13	29.91	70	68	80	65	65.7	75	nne.	3	0.21	3	29.95	29.87
14	29.92	74	68	79	69	67.0	76	nne.	3	0.11	6	29.96	29.87
15	29.96	75	70	80	70	67.7	73	ene.	4	0.01	5	29.97	29.88
16	29.97	74	69	78	74	67.5	76	ne.	5	0.06	6	30.02	29.93
17	29.95	74	68	79	71	65.5	69	ne.	4	0.01	4	30.01	29.92
18	29.93	71	67	80	71	64.5	71	ne.	4	0.03	5	29.98	29.90
19	29.91	73	67	79	70	64.0	69	ne.	4	0.01	8	29.96	29.89
20	29.89	72	68	77	71	66.0	75	n-e.	4	0.02	10	29.93	29.87
21	29.91	74	68	81	71	66.0	72	ne.	2	0.01	8	29.94	29.86
22	29.91	72	68	80	72	66.5	67	ne.	3	0.17	7	29.98	29.90
23	29.91	66	65	80	70	65.2	77	ne.	3	0.03	4	29.98	29.89
24	29.89	66	64.5	81	65	64.7	77	ne.	2	0.00	3	29.97	29.86
25	29.93	74	67.5	80	65	65.3	69	nne.	2	0.01	3	29.98	29.89
26	29.97	73	67	81	73	63.5	66	nne.	2	0.00	2	30.02	29.95
27	30.00	74	66	79	72	63.3	65	nne.	4	0.00	2	30.02	29.92
28	30.01	71	67	80	72	63.5	68	ne.	3	0.02	5	30.02	29.93
29	29.97	72	66.5	79	70	64.0	72	ne.	4	0.08	5	30.06	29.94
30	29.89	72	65.5	78	69	62.5	65	ne.	4	0.01	4	30.01	29.92
Sums.	......	......	......	......	......	......	......	......	......	1.64	......	......	......
Means.	29.95	......	......	79.7	70.8	64.7	69.6	......	‖	......	¶	30.00	29.91
Departure.	0.00	......	......	+1.1	+1.1	......	−6.0	......	......	−4.20	......	......	......

Mean temperature for November (6+2+9)÷3=74.9°; normal is 73.8°. Mean pressure for November is 29.95; normal is 29.95.

*This pressure is as recorded at 1 p. m., Greenwich time. †These temperatures are observed at 6 a. m., local, or 4:30 p. m., Greenwich time. ‡These values are the means of (2+9+6)÷4. §Beaufort scale. ‖Mean for the daytime is 3.8. ¶The mean during daylight is 5.0, whose departure from normal is +0.5.

DECEMBER, 1898.

Date.	Pressure at sea level.	Dry bulb.	Wet bulb.	Maximum.	Minimum.	Dew-point.	Relative humidity.	Prevailing direction.	Maximum force.	Total rainfall.	Average cloudiness.	Sea-level maximum.	Sea-level minimum.
	*	†	†			‡	‡		§				
1	29.91	72	65	80	71	62.8	66	ene.	4	0.00	3	29.95	29.86
2	29.96	72	65.5	79	71	64.0	69	ne.	3	0.02	4	29.99	29.92
3	29.96	73	67	79	71	64.7	71	nne.	3	0.00	6	30.01	29.94
4	29.93	73	67.5	79	72	64.5	69	ne.	2	0.00	6	30.02	29.93
5	29.87	68	64.5	78	72	63.0	72	ne.	3	0.00	10	29.98	29.88
6	29.81	72	69.5	80	66	67.5	85	sw.	1	0.16	4	29.91	29.80
7	29.78	71	69	77	67	69.3	90	wsw.	1	0.56	10	29.86	29.77
8	29.77	64	63	80	69	65.0	85	w.	1	0.02	9	29.84	29.74
9	29.80	66	60	79	63	58.7	68	w-n.	5	0.00	4	29.83	29.71
10	29.92	63	57	74	63	54.3	62	n.	4	0.00	3	29.96	29.86
11	29.98	66	62	78	59	60.0	72	sse.	2	0.00	5	29.98	29.89
12	29.97	64	63	78	62	63.7	80	wsw.	1	0.00	4	29.99	29.88
13	29.97	63	62	78	62	63.7	79	sw.	1	0.00	5	30.04	29.94
14	29.99	73	69	78	61	67.5	79	s.	1	0.13	5	30.01	29.91
15	30.08	70	64	80	69	64.0	79	sw.	3	0.17	4	30.08	30.00
16	30.08	69	60.5	76	67	57.8	63	nne.	5	0.00	2	30.14	30.04
17	29.99	62	60	76	63	59.0	68	nne.	4	0.00	1	30.09	29.99
18	29.96	69	64	76	60	60.3	66	nne.	3	0.00	1	30.05	29.95
19	29.94	67	65.5	77	68	64.3	74	ene.	3	0.01	3	30.01	29.91
20	29.90	64	63	78	64	65.0	80	ene.	3	0.00	5	29.99	29.86
21	29.86	63	62.5	80	63	64.3	85	sw.	2	0.55	6	29.96	29.86
22	29.83	63	62	78	62	62.5	81	w.	2	0.10	5	29.91	29.71
23	29.87	58	56	74	58	64.3	68	nnw.	2	0.00	0	29.91	29.84
24	29.88	67	61	75	57	65.0	61	nnw.	3	0.02	2	29.95	29.85
25	29.86	69	65	74	64	60.0	70	n.	2	0.15	3	29.92	29.85
26	29.91	64	63	76	64	63.3	83	nne.	2	0.13	5	29.92	29.82
27	29.94	63	62	77	62	63.0	81	nne.	1	0.00	1	29.98	29.91
28	29.99	64	63	78	61	64.7	80	e	1	0.00	5	30.04	29.95
29	29.95	71	63	79	62	62.5	67	ene.	3	0.00	6	30.08	29.95
30	29.92	65	63.5	77	70	63.5	72	ene.	2	0.01	6	30.02	29.94
31	29.94	66	65	79	64	64.5	78	s.	2	0.00	2	29.98	29.88
Sums.	......	......	......	......	......	......	......	......	......	2.03	......	......	......
Means.	29.92	......	......	77.6	64.7	62.5	74.2	......	‖	....	¶	29.98	29.88

Mean temperature for December (6+2+9)÷3=70.6°; normal is 71.6°. Mean pressure for December is 29.92; normal is 29.95.

*This pressure is as recorded at 1 p. m., Greenwich time. †These temperatures are observed at 6 a. m., local, or 4:30 p. m., Greenwich time. ‡These values are the means of (2+9+6)÷4. §Beaufort scale. ‖Mean for the daytime is 2.4. ¶The mean during daylight is 4.5.

CLIMATE AND CROPS IN NORTH CAROLINA.

By C. F. von Herrmann, Section Director.

[Note.—The remarks of the Editor of the Monthly Weather Review for October, 1898, page 470, alluding to the difficulty of locating the especial climatic influence that may have produced a good or a poor crop in any specific year, has suggested to Mr. von Herrmann the following brief study into the general relations between the weather of any season and the resulting crop in North Carolina. The results attained by him show that unseasonably cold weather and hot weather are equally liable to be deleterious. If, then, we add frosts, droughts, floods, and gales, we have at least six purely meteorological obstacles to success, and if we add the insects and the parasitic vegetable growths, we begin to realize the difficulties against which the farmer has to contend. And yet, after all, the plant will perfect its fruit and seed if it is in any way possible. In general, the skilful agriculturist helps the plant in many ways known to him, so that the resulting harvest is largely the result of man's ingenuity and only partially the result of climatic influences.—Ed.]

CLIMATE AND CROPS IN NORTH CAROLINA, 1889 TO 1898.

The close of the crop season of 1898 completes a period of ten years during which the complex relationship between climate and the growth of crops has been studied in some detail in North Carolina, and gives opportunity for a brief résumé of the entire decade. Notwithstanding the remarkable variety in the influence exerted by climatic factors and the great difficulty of ascertaining under just what conditions crops flourish best, certain general facts stand forth clearly, and are perhaps worthy of note. It is remarkable, for instance, that the best average crop season experienced in North Carolina was that of the year 1890, following the extraordinarily warm winter of 1889–90; and that the next best season, that of 1894, also followed a relatively mild winter. It is true that the yields of small grains, especially wheat, were poor, and that in 1894 the fruit crop was frost-killed, yet the general excellence of other crops in quantity and quality was marked. In general the past ten years have been characterized by a gradual decrease in the amount of precipitation received up to the middle of the year 1898.

The climatic conditions prevailing during January, February, and March, before the real commencement of growth are important. The favorable conditions are comparatively dry weather, permitting uninterrupted work in the fields, and deficiencies in temperature. It is impossible to separate climatic agencies entirely from the other physical means employed to improve growth; deliberate and thorough preparation of the soil for planting and subsequent active cultivation of the growing crops are the most effective weapons the farmer possesses against adverse climatic influences. Unfortunately he is not always able, however willing he may be, to employ them. The spring of 1895 was in this respect the most unfavorable on account of the very cold, wet weather in spring, which delayed plowing and planting to such an extent that by the end of May crops were from three to four weeks late as compared with an average season. Similar conditions prevailed in the early part of the year 1892. On the other hand, the warm, dry weather of April and May, 1896, permitted such thorough preparation and development that subsequent injurious conditions had a minimum effect.

For good crops it is imperative that March be a cold month. Abnormally warm weather during March forces vegetable growth, and especially the blooming of fruit trees, and great damage invariably results from subsequent killing frosts which always occur in April. This phenomenon has occurred very frequently of late years, especially in 1894, 1897, and 1898. While other seasons have been more favorable in this respect, more or less fruit is always frost-killed in North Carolina in

spring, seeming to indicate that climatic conditions are unfavorable here for raising fruit, except in the western mountainous portions. By far the most advantageous climatic influences are deficiencies in temperature and excess of precipitation during April and May. If the ground during these months is cold and wet, germination and growth are delayed, and become slow and irregular, the difficulty of securing good stands is increased, and notwithstanding occasional remarkable recuperative power of vegetation, as shown for example, in July and August, 1895, the final results following any wet, cold April or May will be unsatisfactory. During the remainder of such years crops seem to be especially susceptible to unfavorable influences. April and May of both 1895 and 1897 were very unfortunate, and May, 1891, particularly so, with frost as late as May 8 heavy enough to kill corn and cotton.

In North Carolina the heaviest precipitation usually occurs in July and August. The experience of the past few years seems to show that the average rainfall for the State is in excess of the real requirements of crops. Moisture is important at this time of the year for cotton, which also can not withstand any considerable deficiency in temperature during July. The mean temperature for July, 1891, was the lowest experienced since 1872, and the cotton crop, which had already suffered from cold weather in May was seriously injured, and was practically ruined by subsequent excessive precipitation in August. Excessive precipitation causes rank growth of all crops and delays formation of fruit and its maturity, and also favors the growth of fungus diseases, as was the case notably in 1898.

Departures from normal temperature and precipitation in North Carolina.

(First column, temperature departures; second column, precipitation departures.)

	1889.		1890.		1891.		1892.		1893.	
January	+ 2.9	+0.91	+10.2	−2.94	+1.3	+0.31	−2.2	+1.70	−10.1	−1.44
February	− 4.0	−0.49	+ 8.0	−0.01	+5.1	+1.49	−0.4	−0.86	+ 0.1	+1.20
March	− 0.3	−1.67	− 0.5	−1.16	−3.1	+3.14	−3.4	−1.26	− 1.1	−2.25
April	+ 0.6	−0.14	+ 0.2	−1.02	+1.0	−1.40	−2.2	+0.21	+ 2.1	−1.24
May	+ 1.4	+0.41	+ 0.6	+0.58	−2.8	+1.17	−0.1	−0.64	− 1.8	+1.36
June	− 0.9	+1.54	+ 3.3	−1.54	+0.8	−0.68	+1.2	+2.31	− 1.3	+1.37
July	− 0.5	+2.15	− 1.4	+1.61	−3.4	+1.07	−1.6	+0.15	+ 0.8	−1.57
August	− 2.3	−0.23	− 1.8	+0.58	+0.3	+2.45	+1.4	−1.94	− 1.1	+1.35
September	− 2.0	−0.38	+ 0.8	+0.91	+0.7	−2.31	−1.8	−0.94	− 0.4	+1.19
October	− 2.3	−1.09	− 0.3	+0.67	−3.5	−1.02	−1.3	−2.98	− 0.2	+1.94
November	+ 2.0	+0.99	+ 2.8	−2.97	−2.7	−0.25	−2.7	+0.34	− 1.4	−0.55
December	+10.3	−3.14	− 1.5	−0.14	+3.3	−1.39	−3.1	−0.92	+ 1.5	−0.60
Year	+ 0.4	−1.14	+ 1.7	−5 38	−0.3	+2.68	−1.4	−4.83	− 1.1	+0.79

	1894.		1895.		1896.		1897.		1898.	
January	+3.4	−0.44	− 1.4	+2.06	−1.6	−1.56	−2.9	−2.05	+4.0	−1.72
February	+0.2	+0.61	−11.5	−1.79	−0.8	+1.43	+1.5	+1.69	−3.6	−3.18
March	+5.8	−2.51	− 0.4	+0.71	−1.3	−1.97	+3.4	+1.00	+5.9	−0.54
April	−1.2	−2.02	− 1.6	+3.58	+3.8	−1.78	−0.9	−0.09	−4.4	−0.07
May	+1:0	−0.21	− 2.8	+0.62	+5.3	+0.07	−2.3	−0.48	+1.6	−0.52
June	+0.1	−1.75	+ 0.2	−0.84	−1.2	+0.99	+0.5	−0.38	+0.5	−0.96
July	−1.4	+0.49	− 1.4	−0.33	−0.2	+2.61	−0.4	+0.02	+0.1	+1.40
August	−1.0	+0.35	+ 0.5	−0.28	+0.9	−3.47	−0.7	−2.37	+1.4	+2.16
September	+1.8	+0.35	+ 3.8	−3.17	−0.1	+0.89	+0.3	−2.95	+1.9	−0.18
October	+0.3	+1.93	− 3.7	−2.56	−2.0	−1 67	+2.7	+0.42	+0.8	+2.85
November	−1.0	−1.90	+ 1.0	−0.17	+5.0	+1.35	+1.5	−0.43	−2.6	−0.08
December	+0.6	−0.20	− 0.2	−0.32	−2.0	−1.22	+1.3	−0.06	−0.5	−0.99
Year	+0.6	−5.30	− 1.6	−1.64	+0.6	−4.33	+0.3	−5.68	+0.4	−1.83

After August adverse conditions, excepting such as result in local loss from heavy rains, floods, or windstorms, have little influence on the ultimate yield of crops. However, early frosts sometimes seriously injure cotton and tobacco. The coldest fall experienced was that of 1892, during which deficiencies in temperature occurred continuously from September to December, with early frost damaging cotton. Both 1896 and 1897 were notable for probably the most severe drought experienced in North Carolina, during the fall, with apparently great deterioration in the condition of crops, yet the final yields were by no means as small as anticipated.

Damage by local storms is comparatively rare. A few instances may he noted: Damage by hail was considerable during May, June, and July, 1891, and in May, 1898. The hurricane of August, 1893, damaged crops throughout the State about 20 per cent by floods and winds.

THE SAN DIEGO WATERSPOUT.

By FORD A. CARPENTER, Weather Bureau.

The weather map on the morning of December 9, 1898, presented the unusual spectacle of an area of high pressure with a crest exceeding 31.1 inches at Denver. Although this high was 600 miles northeast of San Diego, its abnormal intensity was probably responsible for as severe a local storm as this station has ever experienced. The principal feature was a waterspout accompanied by thunder and lightning, which bore a close resemblence to one of the dreaded *chubascos* which rarely occurs north of latitude 18°.

The first instrumental indication was at midnight, when the barometer fell steadily. This was accompanied by a consequent increase in temperature, the thermograph showing an easy upward curve until 2:30 a. m. (local time), when it registered 58°, the maximum for the day. The wind was blowing with gradually increasing velocity from the southeast, south, and southwest, from which last direction a maximum velocity of 23 miles was recorded.

On the evening of December 8, the western sky presented an unusual and beautiful sight. Countless cumulus clouds with well-defined bases, towering tops, and uniform size extended over the southwestern sea as far as the eye could reach. This extravagant display of clouds culminated at 2:30 a. m. in a succession of thunderstorms lasting until nearly sunset. This was the first thunder heard since August 20, 1897. The first shock was unusually loud, rattling the windows and awakening sound sleepers. Rain fell almost immediately to the amount of 0.43, ending at 4.40 a. m. The temperature suddenly dropped 8°, and the barometer rose. The wind shifted to all points of the compass, but with low velocity, settling into a northeast breeze of 20 miles, from which direction a few hours later, it slowly veered to the southeast, attaining a maximum velocity of 35 miles at 9:50 a. m.

It was just before this maximum of 35 miles per hour (the highest velocity of the year), that the waterspout was observed about 8 miles distant a little north of west from the Weather Bureau office, or 2 miles off Point Loma. A gray mass of nimbus cloud overhung the moderate swell of the sea, and from this cloud a convex projection first appeared, rapidly changing its form in an erratic manner, but quickly terminating in a slightly inclined column of whitish vapor. It was about 1,000 feet in height and probably averaged one-tenth that amount in diameter. The location and dimensions of the waterspout were ascertained by considering the observations of several persons located at different elevations and portions of the city, and taking into consideration the known height of the promontory of Point Loma.

For ten minutes this sheath of condensed vapor moved in a northeasterly direction toward the shore with a velocity of about 20 miles an hour, when it apparently dissolved into the black mass of nimbus cloud which, throughout the existence of the waterspout, had served for a background. Shortly after it disappeared, rain fell in torrents on the low hills closely skirting the shore line. At La Jolla, 12 miles north of this station, 3 inches of rain fell in a few hours. The recently plowed grainfields in this locality looked as if tanks of water had been emptied in various spots. Several culverts on the railroads near this place were washed away.

During the night the fishing fleet put into the harbor, and as the other coastwise craft were detained by the gale, the

waterspout was not observed by anyone in its immediate vicinity. This was probably fortunate for the sailors, although a closer observation of this phenomenon would have been highly interesting, as it is believed to be the first time a waterspout has been observed on this coast so far north as San Diego.

THE WEATHER AND STORMS OF MALTA DURING OCTOBER, 1898.

By JOHN H. GROUT, JR., United States Consul at Valetta, Malta.

The month of October, 1898, will long be remembered by the residents of the Maltese Islands on account of its unusually severe storms and rainfall. The rainfall alone from the first to the middle of the month has been more than has been recorded for a like period for a great many years. At the time of the beginning of the usual fall rains, moisture was badly needed by the growing crops. The amount that has this year fallen has been so extensive in quantity as to very seriously injure the crops and add to the prevailing hard times. The soil of Malta is very light in depth, and the overabundance of rain which has recently fallen has proved a disaster instead of a blessing.

On October 1, in the forenoon, a cyclone swept the islands. With it came a great quantity of rain and the result was that everything was flooded. To this was added much destruction by the exceedingly high gale. The storm lasted about three hours.

On October 19, these islands were visited by a severe hailstorm which, it is said here, has never been equalled at Malta.

The stones were indeed of an abnormal size, in many cases larger than a good-sized duck egg, and in some places larger than an orange, several of half a pound were weighed, three in a pound were numerous, and they came down with terrific force, smashing glass and everything breakable right and left, amidst deafening noise. Such a heavy downfall is unprecedented, and the oldest inhabitant can not remember the like of it. Fortunately, the cloud-burst did not last long, otherwise there would have been the danger of roofs giving way under the weight of the ice, which would have accumulated on the terraces.

The storm came indeed as a surprise. A sultry southwest wind had been blowing for some days, and in the morning a breeze from the northwest set in. The weather was fine until about 1 p. m., when banks of clouds appeared in the northwest. But no signs were visible of what was impending. The wind suddenly rose, and shortly after, the storm broke out like a thunderbolt from the blue, just as did the tornado of the 1st instant.

Hail falls nearly every season in Malta, but its size is very diminutive, seldom being greater that one-fourth of an inch in diameter, at times it is a little larger, but the hailstone is practically unknown.

All during this week the *sirocco* has been blowing with an amazing perseverance, but the day before yesterday at 1:20 p. m. the premonitory signs of a storm were seen on the western horizon. Dark, low, heavy clouds began to gather little by little, distant thunder was heard and lightning seen in the skies; these were soon covered over by dark clouds; at 1:45 the *irpar*, as it is called in Maltese, was in full action. The wind veered to the west, it kept on rising higher, clouds of dust were driven before it, and at 2 p. m. the storm was at its maximum. All this time, a distant rumbling noise was heard, everybody was wondering what was the cause of it, but its explanation was soon forthcoming. Hail began to fall and kept coming down for over five minutes.

[NOTE.—We perceive that the local English newspapers as well as the manuscript of our consul speak of the storm of October 1 as a cyclone, a gale, a cloud-burst, a tornado, whereas the storm of the 19th was simply a hailstorm or the Maltese *irpar*. It is not certain that the popular nomenclature in Malta and England is any better than that in the United States.—ED.]

THE AVERAGE FREQUENCY OF DAYS OF HAIL DURING 1893-1897.

By Miss ALICIA DE RIEMER and C. ABBE.

The records published regularly in the MONTHLY WEATHER REVIEW show the number of days in each month on which hail fell at one or more stations in each State. Thus, in Alabama it fell on six days in April, 1893; twice in April, 1894, and three times in April, 1895, 1896, and 1897, respectively, or on the average 3.4 days annually. The following lines give a summary of this published data for the five years. 1893–1897. The relative frequency of hailstorms must be computed from this data by different methods according as we desire to ascertain the relative frequency per month in any one State, or the relative frequency during any month in the different States.

TABLE 1.—*Total absolute frequency of hailstorms during* 1893–1897.

States.	Areas in units of 10,000 square miles.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual. State.	Annual. Unit area.
Alabama	5.1	6	6	17	17	16	13	4	7	4	1	3	4	98	19.3
Arizona	11.4	5	9	9	8	7	6	13	19	16	15	4	2	113	9.9
Arkansas	5.2	4	12	19	37	16	16	6	8	4	4	4	2	132	25.4
California	15.8	22	19	45	36	21	4	8	5	8	9	10	14	201	12.7
Colorado	10.4	0	1	11	18	41	69	60	63	24	19	1	0	307	29.6
Connecticut	0.5	0	3	3	12	1	12	11	6	4	0	2	0	54	108.
Delaware	0.2	0	0	2	3	5	2	2	2	1	0	1	1	19	95.
Dist. of Columbia.	0.01	0	0	1	2	3	1	0	0	0	0	0	0	7	700.
Florida	5.9	3	8	5	13	18	7	3	2	1	0	0	0	60	10.5
Georgia	5.8	2	4	13	21	22	13	10	4	2	2	2	3	98	16.9
Idaho	8.1	0	1	8	38	42	34	13	14	12	9	1	0	172	21.3
Illinois	5.5	2	3	22	47	39	41	25	18	21	11	1	2	232	42.2
Indiana	3.4	1	1	18	34	40	29	18	15	7	1	2	1	167	49.2
Indian Territory.	3.1	1	3	12	10	5	1	0	0	1	2	4	0	39	12.9
Iowa	5.5	2	0	15	42	43	42	34	27	17	6	3	1	232	42.2
Kansas	8.1	1	3	19	57	51	61	22	9	20	9	1	1	254	31.4
Kentucky	3.8	1	4	14	25	23	21	19	22	3	4	0	0	136	35.8
Louisiana	4.1	5	14	21	19	14	7	6	2	0	5	7	3	103	25.2
Maine	3.5	0	0	1	1	7	8	4	2	4	5	0	0	32	9.2
Maryland	1.1	1	0	5	8	17	12	23	16	6	5	4	0	97	88.2
Massachusetts	0.8	0	0	3	14	16	13	20	13	6	5	1	0	81	102.
Michigan	5.6	1	0	10	20	38	26	12	27	13	11	0	0	158	28.3
Minnesota	8.4	0	0	5	29	34	46	27	35	10	2	0	0	188	22.4
Mississippi	4.7	4	13	28	22	16	12	3	2	1	1	2	4	108	23.1
Missouri	6.5	7	7	30	66	47	51	24	18	16	11	4	4	285	43.9
Montana	14.4	0	0	2	8	23	35	29	17	8	6	0	0	128	8.9
Nebraska	7.6	0	0	9	46	33	55	31	29	10	0	3	3	219	28.9
Nevada	11.2	2	0	8	21	26	20	21	12	14	15	7	0	146	13.1
New Hampshire	0.9	0	0	1	5	6	12	9	5	3	6	1	0	48	53.4
New Jersey	0.8	0	0	5	9	12	16	14	12	10	3	8	0	89	112.
New Mexico	12.1	1	2	5	4	19	31	17	20	8	8	3	2	120	9.9
New York	4.7	0	0	8	26	17	23	22	20	16	13	3	0	148	31.5
North Carolina	5.1	2	4	11	18	36	26	16	8	6	3	1	2	133	26.1
North Dakota	7.5	0	0	1	17	31	28	26	21	14	4	1	0	143	19.1
Ohio	4.0	0	1	16	41	45	36	25	21	12	14	3	1	215	53.7
Oklahoma	3.9	0	3	3	28	19	10	3	1	2	2	2	0	73	18.7
Oregon	9.5	7	21	33	33	35	19	10	4	12	6	14	10	204	21.5
Pennsylvania	4.6	0	1	5	19	27	22	27	20	11	5	4	1	142	30.9
Rhode Island	0.1	0	0	0	2	0	0	3	1	2	0	1	1	10	100.
South Carolina	3.4	4	9	3	13	20	21	3	16	0	4	1	3	97	28.6
South Dakota	7.6	0	0	4	20	18	46	39	17	7	2	1	0	154	20.3
Tennessee	4.6	2	3	25	30	22	18	11	8	6	2	3	2	131	28.5
Texas	27.4	8	10	34	45	37	22	8	8	5	7	8	6	198	7.2
Utah	8.4	1	3	5	18	21	22	18	15	12	11	1	1	128	15.3
Vermont	1.0	0	0	1	5	3	7	4	9	2	1	0	0	32	32.
Virginia	6.1	1	2	7	15	29	16	14	10	5	1	2	0	102	16.8
Washington	7.0	1	12	32	47	22	11	2	2	13	17	8	7	174	24.8
West Virginia	2.3	0	1	4	21	22	15	9	4	4	7	3	1	91	39.7
Wisconsin	5.3	0	2	7	27	40	33	21	16	12	7	1	0	166	31.4
Wyoming	9.8	0	0	1	9	3	18	12	9	4	0	0	0	56	5.8

In the latter case, we must divide the monthly averages by the area of the State in order to eliminate the inequality depending on the size of the State. Table 1 shows, 1st, the area of each State, expressed in units of 10,000 square miles; 2d, the total number of dates on which hail fell during the five years, both for each month and for the year. Finally, in the last column, the proportionate total number of hail days for one unit of area. The States in which hail-falls per unit area have been most frequent are the small States, viz, Connecticut, 108; District of Columbia, 700; Maryland, 88; Massachusetts, 102; New Hampshire, 53; New Jersey, 112; Ohio, 54; Rhode Island, 100. But these large numbers result from the smallness of the divisors, and omitting these States from consideration, we find the greatest frequency of hail in

the larger States to be, Ohio, 54; Indiana, 49; Iowa, 42; Missouri, 44. The very largest States have a small frequency, viz, Texas, 7; New Mexico, 10; and California, 14. Florida is credited with only 8, which may be due to the sparseness of observers, but is quite as likely to be a real phenomenon due to the insular character of the climate over the greater part of the peninsula.

TABLE 2.—*Monthly frequency of hailstorms, in decimals of the annual total.*

States.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Alabama	.06	.06	**.17**	**.17**	.16	.13	.04	.07	.04	.01	.03	.04
Arizona	.04	.08	.08	.07	.06	.05	.11	**.17**	.14	.13	.04	.02
Arkansas	.03	.09	.15	**.23**	.12	.13	.05	.07	.03	.03	.03	.02
California	.11	.09	**.22**	.18	.10	.02	.04	.12	.04	.04	.05	.07
Colorado	.00	.00	.03	.06	.13	**.23**	.20	.21	.08	.06	.00	.00
Connecticut	.00	.06	.06	**.22**	.02	**.22**	.20	.11	.08	.00	.04	.00
Delaware	.00	.00	.11	.16	**.26**	.11	.11	.11	.05	.00	.05	.05
District of Columbia	.00	.00	.15	.29	**.43**	.15	.00	.00	.00	.00	.00	.00
Florida	.05	.13	.09	.22	**.30**	.12	.05	.03	.02	.00	.00	.00
Georgia	.02	.04	.13	.21	**.22**	.13	.10	.04	.02	.02	.02	.03
Idaho	.00	.01	.05	.22	**.24**	.20	.08	.08	.07	.05	.01	.00
Illinois	.01	.01	.10	**.20**	.17	.18	.11	.08	.09	.05	.00	.01
Indiana	.01	.01	.11	.20	**.24**	.17	.11	.09	.04	.01	.01	.01
Indian Territory	.03	.08	**.31**	.26	.13	.03	.00	.00	.03	.06	.10	.00
Iowa	.01	.00	.07	.18	**.19**	.18	.15	.12	.08	.03	.02	.00
Kansas	.00	.01	.08	.22	.20	**.24**	.09	.04	.08	.04	.00	.00
Kentucky	.01	.03	.10	**.19**	.17	.16	.14	.16	.02	.03	.00	.00
Louisiana	.05	.14	**.20**	.18	.14	.07	.06	.02	.00	.05	.07	.03
Maine	.00	.00	.03	.03	.22	**.25**	.13	.06	.12	.15	.00	.00
Maryland	.01	.00	.05	.08	.17	.12	**.24**	.16	.06	.05	.04	.00
Massachusetts	.00	.00	.04	.17	.08	.16	**.25**	.16	.08	.06	.01	.00
Michigan	.00	.00	.06	.13	**.24**	.16	.08	.17	.08	.07	.00	.00
Minnesota	.00	.00	.03	.15	.18	**.24**	.14	.19	.05	.01	.00	.00
Mississippi	.04	.13	**.26**	.20	.15	.11	.03	.02	.01	.01	.02	.04
Missouri	.02	.02	.10	**.23**	.16	.18	.08	.07	.06	.04	.02	.02
Montana	.00	.00	.02	.07	.17	**.27**	.22	.14	.07	.05	.00	.00
Nebraska	.00	.00	.04	.21	.15	**.25**	.14	.13	.05	.00	.01	.01
Nevada	.01	.00	.05	.14	**.17**	.14	.14	.08	.10	.10	.05	.00
New Hampshire	.00	.00	.02	.10	.13	**.25**	.18	.10	.06	.13	.02	.00
New Jersey	.00	.00	.06	.10	.14	**.18**	.16	.14	.11	.03	.09	.00
New Mexico	.01	.02	.04	.03	.16	**.26**	.14	.17	.07	.07	.02	.02
New York	.00	.00	.05	**.18**	.12	.16	.15	.14	.11	.09	.02	.00
North Carolina	.02	.03	.08	.14	**.27**	.20	.12	.06	.05	.02	.01	.01
North Dakota	.00	.00	.01	.12	**.22**	.19	.19	.15	.11	.03	.01	.00
Ohio	.00	.00	.07	.19	**.21**	.17	.12	.10	.06	.06	.01	.00
Oklahoma	.00	.04	.04	**.39**	.26	.14	.04	.01	.03	.03	.03	.00
Oregon	.03	.10	.16	.16	**.17**	.09	.05	.02	.06	.03	.07	.05
Pennsylvania	.00	.01	.04	.13	**.19**	.16	**.19**	.14	.08	.04	.03	.01
Rhode Island	.00	.00	.00	.02	.00	.00	.03	.01	.02	.00	.01	.01
South Carolina	.04	.09	.03	.13	.21	**.22**	.03	.17	.00	.04	.01	.03
South Dakota	.00	.00	.03	.13	.12	**.30**	.25	.11	.05	.02	.01	.00
Tennessee	.02	.02	.19	**.23**	.17	.14	.08	.06	.05	.02	.02	.02
Texas	.04	.05	.17	**.23**	.19	.11	.04	.04	.03	.04	.04	.03
Utah	.01	.03	.04	.14	.16	**.17**	.14	.12	.09	.09	.01	.01
Vermont	.00	.00	.03	.16	.11	.22	.13	**.28**	.07	.03	.00	.00
Virginia	.01	.02	.07	.15	**.28**	.16	.14	.10	.05	.01	.02	.00
Washington	.01	.07	.19	**.27**	.13	.06	.01	.01	.07	.10	.05	.04
West Virginia	.00	.01	.04	.23	**.24**	.17	.10	.04	.04	.08	.02	.01
Wisconsin	.00	.01	.04	.16	**.24**	.20	.13	.10	.07	.04	.01	.00
Wyoming	.00	.00	.02	.16	.05	**.32**	.22	.16	.07	.00	.00	.00

The annual frequency for each unit area, as given in the last column of Table 1, is also shown graphically on Chart X, whose numbers give a strong indication that hailstorms are less frequent in the arid regions. In the Gulf States and the Lake region, the frequency is also less than in the central States from Missouri to Ohio. The region of greatest frequency is the middle Atlantic States; in this region, the sleet is doubtless often counted as hail and occurs frequently. Moreover, as before stated, the smallness of the areas of these States renders the quotient or percentage here given liable to exaggeration. If we combine the region from Maryland to Massachusetts in one average, we have the following result:

States.	Areas in units of 10,000 square miles.	Annual frequency.	
		State.	Unit area.
District of Columbia	0.01	7	700
Maryland	1.1	97	88
Delaware	0.2	19	95
New Jersey	0.8	89	112
Connecticut	0.5	54	108
Rhode Island	0.1	10	100
Massachusetts	0.8	81	102
Total	3.5	357	102

The small percentage of 17 for Virginia seems in remarkable contrast to the frequencies in the neighboring States.

The annual periodicity of frequency of hailstorms in each State is found by dividing the monthly sums in Table 1 by the annual total. The results are expressed in decimals in Table 2, where the heavy-faced type indicates the month in which hail is most frequent in each State. The months of March, April, and May occur most frequently, December and January most unfrequently. The earliest month in the year is March for five States; the latest month is August for two States. The greatest number of hailstorms occurred in 1894, the fewest in 1895. Greatest annual number of hailstorms reported in any one State is 76 during 1894 in Colorado.

ANEROID BAROMETERS.

By DR. CHARLES CHREE, Superintendent Kew Observatory.

In the September number of the MONTHLY WEATHER REVIEW pp. 410–412, Prof. C. F. Marvin makes several references to a paper by me, discussing experiments on aneroid barometers at Kew Observatory. I have to thank Professor Marvin for his appreciative remarks, and I should like to discuss briefly one or two of the points he raises, and first the dynamical heating or cooling of the air inside the air-pump receiver in which the experiments were made. In the apparatus used in the special experiments at Kew there are two receivers; the inner (principal) receiver contained the aneroids and a thermometer, and was in constant communication with the mercury gauge; the outer was situated between the principal receiver and the air pump, being connected with them by metal tubes furnished with stopcocks. In all the aneroid experiments the outer receiver was first suitably exhausted, and then by manipulating the cocks on the connecting tube the pressure in the principal receiver was reduced slowly and uniformly, the fastest rate being 1 inch in 5 minutes. The steadiness of the gauge after each elementary exhaustion, and the absence of any creep in the thermometer—except of course when the room temperature was changing—negatived the existence of any sensible dynamical heating or cooling. This is only what we would conclude from thermodynamics having regard to the circumstances. As confirmatory I may mention that on a considerable number of occasions when the aneroids were not in the receiver I observed the effect of suddenly increasing or diminishing the pressure in the principal receiver by 5 or 6 inches in as many seconds. In this case the thermometer shows a small and rapid alteration of reading; part at least of which, however, is due to the change of the external pressure on its bulb.

As Professor Marvin draws an argument in favor of large aneroids from a remark of mine respecting the behavior of a certain group of instruments, I may say that, according to my experience, after effect is greatest on the whole in small aneroids. Still, one not infrequently finds more after effect in an individual 4½-inch aneroid than in a 1½-inch aneroid, especially when the latter covers a wide pressure range. The particular aneroids I referred to were of the largest common size, 4½-inch diameter, but in no way exceptional in that respect. Even in the case of aneroids from a single maker, the phenomena do not depend on the size alone. The fact that such variations exist without any apparent reason, so far as the maker seems to know, may appear discouraging. Biologists insist, however, that there is nothing like the existence of sports or varieties in species for facilitating the action of natural selection, and if the Kew observatory committee should find themselves in a position to lay down regulations leading to the rejection of the unfittest aneroids, I should expect very decided improvement.

I entirely agree with Professor Marvin that the ideal thing

is the total elimination of after effect, provided this should introduce no other evil. It sometimes happens, however, that the elimination of Scylla widens the jaws of Charybdis, and a careful eye should be kept on other properties.

Professor Marvin apparently considers the laws evolved in my paper too complicated for practical use. This must depend partly upon the intelligence of the observer, as well as on the ability of the individual reducing the observation. By putting, however, the aneroid used in an ascent, or a similar one previously compared with it, through an analogous series of pressure changes in a receiver, it seems possible, as explained in my paper, to reduce very largely the uncertainty of the results. The difficulty of treating the results would be much reduced if the aneroid readings *at all pressures* were independent of the temperature.

By a printer's error, the date of my paper is given in Professor Marvin's account as 1895 instead of 1898.

CIVIL SERVICE EXAMINATIONS FOR OBSERVERS IN THE UNITED STATES WEATHER BUREAU.

By H. H. KIMBALL, Weather Bureau.

It has been my privilege to assist the Civil Service Commission in marking the papers on meteorology and the essays on meteorological subjects submitted at the regular semiannual examinations, April 27 and September 27, 1898, which were held in all parts of the country in order to obtain a list of eligibles for the position of "Observer, United States Weather Bureau." Judging from these examination papers, a majority of the applicants were already connected with the Bureau either as messengers, watchmen, voluntary observers, or in some other capacity that offers opportunity for obtaining practical knowledge in meteorology. It might, therefore, not be out of place to offer a few suggestions through the pages of the MONTHLY WEATHER REVIEW to those intending to take the examination at some future date.

While the relative standing of candidates depends very largely upon the percentages made in meteorology and essay writing, it should be remembered that the examination also embraces geography, penmanship, spelling, letter writing, copying, and arithmetic. It frequently happens that a passing grade is attained in the former, only to be reduced below the standard by failure in the latter subjects. The necessity of, at least, a very thorough common school, and, if possible, high school, education is therefore apparent.

Furthermore, without a thorough knowledge of the English language and the ability to use it, born only of experience, one can not hope to write a creditable essay, or to compose his answers to the questions in meteorology so clearly that the examiners will have no doubt as to his meaning.

The meteorological papers submitted enable us to group the writers into three quite distinct classes: First, those whose papers show evidence of thorough and careful preparation, and a consequent mastery of the subject. Second, those whose papers show little or no attempt at the necessary preparation. Thus, one poor fellow wrote out all he knew about *condensation* and *precipitation* in about ten words, and acknowledged that he had no time for study. Another described the *dew-point* as a *needle point of steel*, and determined it by the *rise and fall of the barometer;* and still another described a thunderstorm as a *burning up of the carbonaceous matter and surplus nitrogen of the air.*

The first class will get along very well without any suggestions, and we have none to make to the second class further than that they cultivate the studious habit.

The third, and perhaps the largest, class of applicants is composed of those whose papers bear evidence of ill-directed and unprofitable preparation. Apparently, considerable reading had been done, and many scientific terms had been committed to memory without any clear conception as to their significance. In fact, most of the work done has been memory work, and even the elementary principles of meteorology have been left unmastered.

Such preparation might enable one to define a *foehn* wind or a *col*, but would hardly prepare one to distinguish between climate and weather.

To such we would say that the observer's examination in meteorology, while it aims to be elementary and practical, is quite comprehensive in its character, and a mastery of the elementary principles of the subject is essential. The study of high-sounding terms and theories that are more or less speculative need not be attempted by the applicant, but may be postponed to a later period of study. Thoroughness in first principles should be the watchword; master every inch of ground that is covered, even if you do not get beyond the most elementary of books. But be sure *that* book is up to date, for meteorology has developed greatly in the last twenty years.

In essay writing, it is a good rule not to attempt to write about that of which one has no knowledge. A candidate who admitted that he knew nothing about the arid region of the United States and, therefore, wrote about the weather at his old home, did more creditable work than a fellow competitor who described the arid region as *a good place for bears and other animals covered with wool; but, on account of numerous icebergs, it was not a good place for navigation, for the abode of man, or for vegetation.*

The element of chance in these examinations is very small. In one way or another, a man is sure to show just how much he knows. If, therefore, he is to compete successfully with his fellows, he must thoroughly understand the subjects upon which he is to be examined, and must say no more than he is sure of.

CLIMATE AND CROP REPORT, SEASON OF 1898, ALASKA SECTION.

By H. L. BALL, Section Director.

The District of Alaska is nearly or quite as large as that part of the United States east of the Mississippi River. The greater part of this vast territory lies between the one hundred and thirtieth and one hundred and sixty-sixth degrees of longitude, and the fifty-second and seventy-first parallels of latitude—or, its length lies along the parallels and not longitudinally, as is the case with the Eastern States. For climate and crop study two divisions may be made: the southern coastal region, and the interior, each characterized by extreme ruggedness, often inaccessibility, and having a different climate.

The sweep of the ocean current along the whole southern coast gives that section a more temperate and uniform climate than the interior, or than would otherwise be found in such high latitudes, The presence of this warm current and the peculiarly intricate mountain system of the coast line unite to produce a climate having comparatively small temperature range and an excessive precipitation. Where it is otherwise, and sometimes such is the case, local topographic features cause the difference.

Southeastern Alaska includes all the Alexander Archipelago. This section is a labyrinth of mountainous and heavily timbered islands interlaced with numberless narrow channels. The general trend of the mountains is parallel to the coast line. Meteorological records at Sitka fairly represent the general climatic conditions prevailing throughout the section, although there are localities that show variations which are only to be accounted for by peculiar local topography.

Northwest of the Alexander Archipelago is Yakutat Bay.

There the mountains are farther from the coast line and a dryer climate is had, with greater range of temperature and more sunshine. Still farther westward is Prince William Sound. This sound is dotted with a great number of islands, many of which attain considerable elevation. The coast of the mainland is precipitous and deeply indented by narrow arms. Here the climate appears to differ greatly from both the Yakutat country on the east, and Cooks Inlet which lies to the westward over the Kenai Peninsula. I know of no statistics of temperature or rainfall for Prince William Sound. Persons long resident there say that precipitation is almost of daily occurrence, especially during the summer months.

Three hundred miles southwest of Prince William Sound is Kadiak Island, and north of that island is Cooks Inlet, justly called the garden spot of Alaska. Cooks Inlet and Shelikoff Strait are narrow sheets of water lying between the mountainous Kenai Peninsula on the east, and the Alaskan Peninsula and the mainland on the west. In the inlet extensive table lands, having an elevation of 100 or more feet, stretch away from the water to the mountains, a distance of from 30 to 50 miles. Near the entrance to the inlet the mountains lie along the coast, and this is the case with the Shelikoff Strait, except that the mountains of Kadiak Island and Afognak are less rugged than the lower part of the Kenai Peninsula. Thus Cooks Inlet is a great basin inclosed by high mountains, except at the entrance. The Alaskan Peninsula and the Aleutian Islands become less rugged to the westward, trees disappear after Kadiak Island is passed, and the climate becomes purely marine.

The southern coastal region appears destined to take its proper place, at no distant date, as an agricultural region, certainly as a magnificent stock range. Other pursuits, such as mining, trading, and fishing, which yield quicker income to invested capital, have hitherto prevented all but a very few from attempting to develop the agricultural resources of the country. Gardening in a small way is about all that has been done, although it has long been believed, in fact known, that many of the hardier cereals and fruits can be successfully grown. That this has not been done is not because of an unfriendly climate.

At Sitka and other places in southeastern Alaska the past season was a remarkably good one, but by no means unparalleled. The winter rains ceased early. April and May weather was about as usual, that is, rains were light and frequent, with clear, bright days intervening and a gradual increase in temperature. The gardens of the Agricultural Experiment Station were planted during the latter part of May. By that time the ground held sufficient heat to insure prompt germination and by the close of the month the young vegetables, grain, and flax were well started. The first two weeks of July were remarkably dry and sunshiny. Little or no rain fell during that time and temperatures above 80° were noted on the 8th, 9th, and 10th. This period of fine weather, the warmest of the season, gave all the young plants a good start and the rapidity of their growth was truly wonderful. It is surprising with what rapidity plant life starts, develops, and attains an almost tropical luxuriance in Alaska. At Sitka, during the last half of June, 1.39 inch of rain fell, the maximum temperatures ranged between 56° and 70°, and upon but one day did the temperature fall below 45°. During July 3.97 inches of rain fell; the temperature ranged between 43° and 68°, with an average maximum of 60° and minimum of 49°. The greater part of the month's rainfall occurred between the 22d and the 26th, the first three weeks having 1.40 inch, evenly distributed as showers. The rainfall for August was 3.92 inches. Of this amount 3.11 inches fell during three days, the 22d, 27th, and 31st, the first three weeks having but 0.58 inch. The temperature ranged from a minimum of 42° on the 28th to a maximum of 78° on the 10th, with average maximum 63° and average minimum 49°. The month had an abundance of sunshine and all the crops made excellent growth.

The early part of September was dry and warm, with many bright days. The first eleven days gave 0.48 inch of rainfall, and the temperature on the 9th and 10th reached 73° and 74°, respectively. After the 11th, winter types of storms appeared, barometric fluctuations were more irregular and rapid and of greater amplitude, while rainfall was of almost daily occurrence. On the 18th and 19th the skies cleared and heavy frosts fell, however, without damage to the garden vegetables; 5.98 inches of rain fell during the month; the range of temperature was from 33° on the 19th to 74° on the 10th, with average maximum of 59° and average minimum 45°. October opened clear, cool, and bright, and this weather continued until the 6th; a fitting prelude to the continuously stormy weather which followed. Heavy frosts fell on the 1st and 2d, and killing frosts on the 3d, when the ground froze slightly. These frosts killed what was left of the gardens and destroyed the buckwheat seeded by the Agricultural Experiment Station. This crop was, however, sown late, otherwise it would have matured before the frosts.

The vegetables and grains seeded in the latter part of May at Sitka have all done remarkably well, in fact many of the former grew better than they do in the central States, and the clover produces a heavy crop. Barley and oats seeded on the 23d of May matured plump and heavy seed by the 25th of September. Canada field peas produced vines 10 to 12 feet long, loaded with pods. The English Windsor bean, a vegetable that is not appreciated at its true value in the States, grew 4 feet high, bearing an abundance of pods. In like manner cabbage, cauliflower, carrots, parsnips, turnips, parsley, radish, lettuce, beets, and in fact everything that was attempted grew to perfection.—*Prof. C. C. Georgeson.*

At Killisnoo, during May, 2.90 inches of rain fell. The temperature ranged from a minimum of 32°, on the 2d, to a maximum of 55°, on the 14th and 15th, with an average maximum of 57° and minimum of 37°. Very little rain fell until the 17th; after that date light rains were frequent until the 29th, and little or no sunshine occurred. For June the voluntary observer reported 1.05 inch of rain, the whole of which fell on four days. The temperature ranged from 35° on the 2d, to 69° on the 15th, with an average maximum of 62°, minimum 43°, and 7 clear, 10 partly cloudy, and 13 cloudy and rainy days. During July 4.30 inches of rain fell; of this amount 0.80 inch fell during the first seventeen days, the remainder falling between the 18th and the 26th. Maximum temperature for the month, 69°, on the 9th; minimum, 44°, on the 29th. Average maximum, 62°; minimum, 48°. For August the same observer reported 1.30 inch of rainfall, the whole of which fell after the 22d of the month. Highest temperature, 71°, on the 9th; lowest, 41°, on the 7th. Average maximum, 64°; minimum, 47°. There were 9 clear days, 11 partly cloudy, and 11 cloudy and rainy. The gardens yielded fully as well as at Sitka. In the latter part of September I saw as fine potatoes there as I ever saw in the States. Though not as large as some grown in the States, they were of excellent marketable size, well formed, and plenty in the hill.

In western Alaska, along the coast and in Cooks Inlet, the season was the most unfavorable in many years. Many long-resident Russians and all the Americans, some of whom have resided in the country ten or more years, said they had never before seen so much rain and so little sunshine as during the past summer. May, June, and the first half of July were, as usual, favorable months, but rainstorms set in about the 20th of July, and from that time onward there were but few pleasant and many cold, rainy days. In Prince William Sound the whole summer was wet and cold, with now and then a clear

or partly-cloudy day. On August 16, at Orca, I observed snow-flakes flying. Little or no systematic attention is given to gardening in the Sound. At Orca a small garden of radishes, turnips, and like root crops had been planted, but the yield was miserably poor. At Kadiak the gardens in the early part of July were in a very flourishing condition; potatoes and other vegetables had a splendid growth. Kadiak Island and the other islands of that group were covered waist deep with luxuriant grasses and flowers of many varieties. The traveler is struck with amazement at the floral wealth of that country, which, though comparatively treeless, offers thousands of miles of pasture unsurpassed by any State in the Union. The plateaus of Cooks Inlet, too, were covered with long, rich grasses, many kinds of which make excellent food for cattle. At Kenai, Kussiloff, Ninilchek, Anchor Point, and Homer, all on the east side of the Inlet, gardens had been planted, and at each place the yield was good, but was said to be poorer than usual, on account of the unfavorable weather during the latter part of the summer. At Kenai and Ninilchek I saw cattle which had probably never tasted grain; yet they were fat and healthy.

The woods and meadows of that country abound with berries of many varieties, all having an excellent flavor. Fuel, both coal and wood, can be had without asking, and fish and game are abundant. The soil is easily cleared, yields quickly and bountifully, with a minimum amount of labor, and there are few or no harmful vegetable insects. During a stay of several weeks in the Inlet this past summer I did not once observe a higher barometer reading than 29.92 inches, while outside the Inlet I frequently observed readings of 30.00 and higher. The winds were either southwest or northeast, up or down the Inlet. The few opportunities I had for observing the movement of cirrus clouds showed them as coming from the southwest.

The chief hindrance to the early and thorough settlement of that country appears to be its great distance from markets, its isolation during a large part of the year, and the mosquitoes and sand flies during the summer months; mosquitoes are a pest beyond description. One who has never been in the country can form no idea of the annoyance they cause, both night and day. Of course, with the clearing of the land this pest would disappear to a great extent.

At Tyoonok and Ladds, on the west side, gardening is more extensively engaged in than at any other point in the Inlet. It was said that usually the potato crop is ripe by the 4th of July, and that it yields well. This year the crop was not of eatable size by the first of August, and did not promise to be a good one. Rains and cloudy weather prevailed throughout July and August, and frequently the days were raw and cold.

At Coal Harbor, on Unga Island, about three hundred miles southwest of Kadiak, the voluntary observer's report for August showed 2.25 inches of rainfall, with 3 clear or partly cloudy days, and 28 cloudy and rainy days. The range of temperature was from 43° to 60°. For September the same observer reported 1.02 inch of rainfall, with 7 clear, 8 partly cloudy, and 15 cloudy and rainy days. Maximum temperature, 66° on the 12th; minimum, 34° on the 27th and 28th Records from that station for previous months have not been received.

The only meteorological records received from the interior were those from Holy Cross Mission (Koserefsky) on the Yukon. At that place 33 inches of snow lay upon the ground at the close of April. In May the total precipitation was 0.20 inch, with 5 clear, 16 partly cloudy, and 10 cloudy and rainy days. The highest temperature for the month was 58° on the 28th; the lowest, 15° on the 9th. For June the rainfall was 2.09 inches, with 8 clear, 14 partly cloudy, and 8 cloudy and rainy days. Maximum temperature, 76° on the 11th; minimum, 53° on the 3d, with average maximum and minimum of 67° and 45°, respectively. During July 3.34 inches of rain fell. There were 9 clear, 7 partly cloudy, and 15 cloudy or rainy days. Highest temperature, 80° on the 15th; lowest, 40° on the 29th. Average maximum, 65°; minimum, 48°. For August the record gives 2.96 inches of rainfall, with 1 clear, 8 partly cloudy, and 22 cloudy or rainy days. Maximum temperature, 68° on the 22d; minimum, 37° on the 7th and 30th, with averages of 61° and 47° respectively. For September 2.43 inches of rain were reported. Clear days, 3; partly cloudy, 11; cloudy, 16. The first snow of the season fell on the 21st. Maximum temperature for the month, 60° on the 1st; minimum, 25° on the 23d and 24th.

NOTES BY THE EDITOR.

CAPT. MICHAEL MAHANY.

A large majority of the observers and officials of the Weather Bureau will, with regret, learn of the death of Captain Mahany at Washington, on February 3, 1899. For many years during the existence of the school of instruction in signaling and meteorology, at Fort Myer (formerly Fort Whipple), Va., Captain Mahany was the first sergeant, and as such, came into intimate daily contact with every member of the successive classes under instruction. His special attention was given to the care of the men, and their quarters and their instruction in military drill and signaling. He was emphatically and naturally a soldier, and was an excellent drillmaster; although a strict disciplinarian, he was thoroughly faithful to the best interests of those entrusted to his care, and no superior officer ever thought of replacing him by another. When the meteorological, was separated from the military, service, Captain Mahany cast his lot in with the former, and when Professor Moore was appointed Chief of the Weather Bureau, he soon showed his appreciation of the merits of his former drillmaster by recommending him for appointment to the very responsible position of Captain of the Watch, which position he filled with marked acceptability. He will be sadly missed by every one. He was a prominent member of "The Old Guard," and was buried at Arlington with military honors.

REDUCTION TO STANDARD GRAVITY.

In the MONTHLY WEATHER REVIEW for July, page 314, we have explained the process by which we pass from crude barometric readings at any station to the true atmospheric pressure expressed either in inches, as the height of a column of mercury or, still better, in pounds to the square inch, as pressures are more appropriately measured. One step in this process consists in applying the reduction to standard gravity. Now, the reduction to standard temperature has been acceded to and practiced for the past sixty years; but the reduction to standard gravity has been applied only in special cases, and its general application has been delayed until there could be a concert of action among all nations. Its importance and magnitude has been recognized ever since Laplace published his Mécanique Céleste. The international congresses of Vienna, 1873; Rome, 1878; Munich, 1891; as well as the Permanent International Meteorological Committee, have

expressed themselves in no uncertain terms to the effect that, for general meteorological purposes, the reduction to standard gravity is imperative, and that it should be uniformly adopted by all national services and not later than January 1, 1901. In fact, the Polar Conference had already urged this step in 1884 as imperative even at that time, and the Chief Signal Officer, General Hazen, acting promptly upon this request, introduced this correction with the monthly constants for January, 1885, and continued it, in connection with Ferrel's reduction to sea level, on August 1, 1886; but, on January 1, 1888, this improvement was abandoned in order to await the general action of all national services. The recent extension of the service of the Weather Bureau so that our daily weather maps now comprehend the region from latitude 10° to 55° north, brings the importance of the gravity question into great prominence, and by recent instructions, No. 92, dated October 19, the correction will be applied to all mercurial barometers of the Weather Bureau on and after January 1, 1899. The correction will be applied at the same time with those for temperature and other instrumental errors, thus giving first the correct pressure in standard inches of mercury for the locality of the barometer. This local pressure is then reduced to sea level or to any other desired altitude, and the new pressures thus obtained will also be expressed in terms of the recognized international standards.

INSTRUCTIONS No. 92, 1898.

Owing to the recent extensions of the Weather Bureau in the West Indies and along the South American coast, the whole territory now reporting barometric pressures embraces a wide range of latitude, and the barometric readings corrected for temperature and instrumental error only, at the extremes, are widely discordant, owing to variations in the force of gravity with latitude. Therefore, on and after January 1, 1899, the appropriate correction for gravity will be applied to all barometric readings. This correction is nearly constant at any one station, and is given in Table II, page 66 of Circular F, Instrument Room. The gravity correction to be used at a station will be incorporated with the correction for instrumental error and capillarity, and a correction card giving the appropriate correction for each instrument will be furnished by the Instrument Division.

The following example will elucidate the complete correction of the barometric reading:

Attached thermometer 76.5°; observed barometer reading	30.287
Correction for temperature	—0.131
Correction for gravity, instrumental error, and capillarity	—0.066
Total correction	—0.197
Corrected reading	30.090

The total correction, ascertained as shown above, will be entered on Form No. 1001-Met'l in the column in which the correction for temperature has been recorded heretofore. Observers may find it convenient to compute a small station table, by combining once for all the gravity and instrumental error corrections with those for temperature, thus giving the total correction for the ordinary temperatures and pressure that prevail at their stations. A new table must be prepared, however, whenever a new correction for instrumental error is employed.

The corrected reading, derived as above, is a standard measure of atmospheric pressure, and is perfectly comparable with similarly corrected readings made at any place the world over.

It takes a long time to overcome the conservatism of the practical world. Men are so accustomed to think in the terms taught them in childhood that even after they have long since perceived that those terms have acquired a new significance and ought to be expressed by new words, or new standards, they still hold on to the old ones.

They may know that the barometer is affected by the temperature of its scale and its mercury, and that both the atmospheric pressure and the weight of the column of mercury depend upon the downward pull of the force of gravity, but they may be slow to take the trouble to make the necessary corrections and allowances. Exact meteorology is now engaged in studying the atmosphere as a whole and demands that atmospheric pressure should be everywhere measured by the same standard and not by one that varies with the temperature or the latitude. There was a time when every city and country could have its own standard foot, pound, and bushel, but this confusion is now largely abolished in commercial matters and must, also, be abolished in science. We must measure pressure in some uniform standard unit, such as the weight of a pound of mercury, or the height of a column of mercury, under standard gravity. The pressure, per square inch, that will hold up fifteen pounds of mercury under the standard gravity that prevails under 45° of latitude and sea level, will not hold up so much mercury when the attraction of gravitation upon the mercury increases, as it does do as we go northward toward the pole. The reduction to standard gravity is simply an effort to convert our measurements of atmospheric pressure into one common unit so that they will be strictly comparable among themselves all over the world.

THE PRACTICAL SIDE OF WEATHER BUREAU WORK.

The observers in charge of Weather Bureau stations are expected to be, not merely faithful observers and studious meteorologists, but also eminently practical men. That is to say, they must know when, where, and how to apply their knowledge to the best interests of the community around them, and that community consists not merely of the citizens of the city or town in which the station is located, but also includes all the country tributary thereto. We have not yet learned that any other government weather bureau has called upon the merchants or citizens to form local meteorological committees to advise with the local observers as to their mutual interests; but this is always done by the United States Weather Bureau, and has been one of the most important means of securing the appreciative support of the people. We are led to these remarks by a paragraph in the recent annual report of the Chamber of Commerce of Chattanooga, commenting upon the work of our observer in charge, Mr. Lewis M. Pindell. Of course, this report is but one of hundreds that are made from time to time by every local committee on meteorology. If similar committees were established in other countries, their respective weather services would, perhaps, profit thereby as the United States Weather Bureau has done.

THE WEATHER BUREAU AND THE LIBRARIES.

Although the publications of the Climate and Crop sections are widely distributed in their respective States, yet it has always been difficult to secure sets of them for preservation in libraries outside of the States. In order to remedy this difficulty, the Chief of the Weather Bureau has directed that complete sets of all the monthly reports of sections be deposited with the larger libraries of the United States, and the special meteorological libraries of foreign countries. The list thus far agreed upon is as follows:

The Library of Congress, Washington, D. C.
The Free Public Library, San Francisco, Cal.
The Public Library, Chicago, Ill.
The Public Library, Boston, Mass.
The Public Library, St. Louis, Mo.
The Astor Branch of the Public Library, New York, N. Y.
The Meteorological Office, Toronto, Canada.
The K. P. Met. Institut, 6 Schinkelplatz, Berlin, W.
The Deutsche Seewarte, Hamburg, Germany.
The Centralanstalt f. Met., Vienna, Austria.
The Central Physical Observatory, St. Petersburg, Russia.

The Bureau Central de Météorologie, Rue de l'Université, Paris.

The Meteorological Office, 63 Victoria street, London, S. W.

The Indian Meteorological Office, Calcutta, India.

THE CHEMICAL THERMOSCOPE.

We copy the following from the Scientific American for November 26; it describes the method of making a little instrument that is found in many houses and is frequently called a barometer, or sometimes a "weather indicator" or a chemical hygrometer. Probably all these names are quite inappropriate and misleading. The liquid within the glass is so sealed up that neither the pressure nor the moisture of the external air can have any influence upon it. It is really a form of thermoscope; the changes in the appearance of the liquid within the glass depend upon the temperature only and can have no more connection with future weather than the changes in a thermometer. A great many other combinations of chemicals dissolved in water, alcohol, coal oil, or other liquids can be constructed to show the rise and fall of the temperature, but an ordinary thermometer is, of course, much better. The Editor does not believe that the instrument described below can have any value, either as a thermometer or barometer, hygrometer or weather indicator. In one location or at one season of the year, it will predict clear weather, but a few hours later, when the temperature of the room changes, its own indications will change correspondingly, and it will predict rain or snow. Nevertheless, as many inquiries have been received, asking for the method of construction, we submit the accompanying with the special request that if any of our observers constructs one of these thermoscopes, he will kindly keep a record of its appearance at every daily maximum and minimum temperature for a month or more and study out its value as a weather prophet.

Dissolve 10 grammes of camphor, 5 grammes of saltpeter, 5 grammes of sal ammoniac, in 105 grammes of alcohol (90 per cent) and 45 grammes of distilled water. After filtering, fill glass tubes 2 centimeters wide and 50 centimeters long with this solution, cork up well below and above, seal and fix on boards by means of wire, similar to barometers. The changes of the solution signify the following: Clear liquid, bright weather; crystals at bottom, thick air, frost in winter; dim liquid, rain; dim liquid with small stars, thunderstorms; large flakes, heavy air; overcast sky, snow in winter; threads in upper portion of liquid, windy weather; small dots, damp weather, fog; rising flakes which remain high, wind in the upper air regions; small stars in winter on bright sunny day, snow in one or two days. The higher the crystals rise in the glass tube in winter, the colder it will be.

KITE WORK IN MADEIRA.

According to Nature, 1879, Vol. XX, p. 444, in the Report of the British Association for 1879, p. 63, will be found the Report of the committee on atmospheric electricity in Madeira, by Dr. M. Grabham, who gave himself to the observation of the regular winds and breezes and their connection with electrical phenomena. Of course, the kite was used for this purpose, and Dr. Grabham notes that—

The thinness of the currents of air constituting sea breezes was demonstrated in the bay of Funchal by flying a kite vertically beyond into the true wind blowing in a contrary direction. Abortive attempts were made to bring down the upper electricity through the lower currents. The electricity of the general northeast wind, which is identical with the trade wind, was found on the heights at the east end to be uniformly moderate and positive.

At the approach of the rain clouds at the termination of a period of fine weather, the atmosphere invariably gives increased readings, and no negative observations were recorded.

The kite is specially adapted to the study of the sea breeze, which usually constitutes but a thin layer of air, and should be applied by those who resort to the shores of our oceans and Great Lakes.

PROGRESS IN KITE WORK.

The October number of the Quarterly Journal of the Royal Meteorological Society contains an historical article by Mr. A Lawrence Rotch on the work done at the Blue Hill observatory in the development and use of the kite. In the discussions following this excellent article, Mr. R. C. Mossman gives an account of the work done by Mr. John Anderson, late of Owensboro, Ky., but now residing in Edinburgh, in flying kites at the latter city for meteorological purposes.

Capt. Baden Powell explained the construction and management of his form of kite. Mr. Rotch stated that the Baden Powell kites had been tried at Blue Hill, and that, although they started in a lighter wind than the Hargrave kites, yet they were not sufficiently stable in winds of varying velocity without using side lines, which precluded the attainment of great height.

Mr. R. C. Mossman stated that from work done by Prof. Michie Smith on the summit of Dodabetta, India, it was found that the electric potential on the edge of a dissolving mist is lower than the normal, while in a condensing mist it is higher than the normal. It is proposed to make observations on this point by the use of kites near Edinburgh, in order to ascertain whether the same phenomenon occurs in the free air as on the mountain tops.

ORIGIN OF TORNADOES.

Dr. B. F. Duke, of Pascagoula, Miss., sends an account of a tornado observed by him in April, 1894, possibly at or near that place.

I was located on the edge of a track about a mile and a half wide, within which nearly everything was swept before the wind. It was a cloudy day, and thunder and rain had been observed all the afternoon in the west under very dark clouds. About 6 p. m. these clouds suddenly became very black in one place while everything around the observer was very calm and still. Soon a terrific roaring could be heard in the distance. As it approached, a low stratum of muddy cloud could be seen in the west, flying from northwest to southeast, while another stratum was coming up equally fast from the south, and puffs of wind from these two directions were alternately felt by the observer. All this occurred a little in advance of the dense black cloud, which was streaked with lightning, though not funnel-shaped so far as we could discern. When it (the tornado?) had passed by us, it was seen that the timber on the north side of the track was blown to the southeast while that on the south side fell toward the north, but in the center, or nearly so, it was piled in every direction and in the greatest possible confusion. In some places the wind seemed to have made all sorts of breaks and deflections, blowing in strips of a quarter of a mile or more, directly opposite to the general course which was nearly northeast. In some of these dashes, if we may so speak of them, it (the wind?) would appear to have been heavier than in the main body of the storm.

What conditions of the earth and air give rise to the south and the northwest winds and the clouds that preceded the hurricane?

Is there not a strong attraction between them? When they meet, is not this affinity neutralized? Had these winds been coming from exactly opposite directions, would not the cyclone (tornado) have occurred throughout the whole length at the same moment? Does a tornado actually travel, or is its velocity to be reckoned by the acuteness, or obtuseness of the angle of these two approaching currents, which might be illustrated by two lines of battle advancing toward each other at the angle indicated, namely, one moving from south to north, the other from northwest to southeast; the time required for the two entire lines to meet depending upon the speed maintained?

In the United States when the weather map shows a center of low pressure, there is generally an extensive area of cold northerly winds and high pressure west of the center; but a region of warm southerly winds south and east of it. What conditions of the earth and air give rise to these winds? The only answer must be that the differences in density of different portions of the atmosphere cause these portions to be acted upon differently by the attraction of gravity and by the centrifugal force of the revolving atmosphere. Gravity pulls the denser air down, so that the cold northwest wind

underruns and lifts up the warm, moist, southerly wind. Centrifugal force drives the denser cold air toward the equator, pushing the lighter, warm air out of its way, and forcing the latter upward and backward toward the polar regions. These are the principal mechanical conditions that give rise to the winds and clouds that precede such tornadoes as those in northern Mississippi on April 8–9 and 18–19, 1894.

On both these dates a cold, dry, northwest wind was advancing southward over the State as the front edge of an area of high pressure, while warm southerly winds were prevailing everywhere to the southward and eastward. The northwest winds were much stronger than the southerly winds, but they, themselves, did not constitute a tornado, nor could they have done the damage described without another auxiliary process. At the front of the area of northwest wind, where it ran under the south wind and lifted it up, as the nose of a plow lifts and turns the sod, there was formed a cloudy mass due to the rapidly uprising air. The buoyancy within such a cloud is very great. When once well formed, it may suck up the air beneath it with such violence as to form a waterspout over the ocean or a tornado over the land and the winds immediately below it are suddenly and greatly increased. It is these winds under the tornado cloud that do most of the destruction; they start toward the cloud as increasing northwest and south winds on the two sides of the track, but rapidly become deflected into circulating winds, under the cloud, extending sometimes even down as low as the ground itself. The individual clouds and whirls along the front of the northwest wind depend very much upon local irregularities, hills and valleys, rivers and ponds; in some cases there may be a long series of whirls simultaneously existing; at other times only one or two acquire any prominence; again, it may be as suggested by Dr. Duke, that there is an advancing front for the southerly winds as well as for the northwesterly, and that the whirl exists only at the one vertex where these two fronts intersect. All these and other cases may occur; but the last is certainly the least common because there is almost always a steady flow of southerly winds over a very large area of country and the front of the northwest wind is everywhere penetrating this and pushing under it simultaneously so that the southerly front has no independent existence.

We can not agree with the suggestion that there is a strong attraction between the northwest and the south winds, or that there is any neutralization of affinity; the winds represent simply two masses of air driven along the earth's surface by the pushing forces that are at work everywhere in the atmosphere and which are ultimately resolvable into two elementary forces, the attraction of gravitation and the centrifugal force of bodies that revolve with the diurnal rotation of the earth. These two forces will cause warm, moist air to push northward while cold, dry air is pushed southward and the tornadoes start in the narrow belt where the northerly winds push against the southerly.

In many cases a tornado involves a large mass of cloud and may be properly said to move bodily for quite a long distance along the earth's surface, as shown by its path of destruction. At other times a tornado rapidly dies out, but only to be quickly succeeded by another, so that the path of destruction is due to a series of newly-formed successive whirls. The axis of the whirl is oftentimes very much inclined to the earth's surface and it is possible that we may have violent whirls with horizontal axes; but they could not last very long.

METEOROLOGY IN FRANCE.

The Annals of the Central Meteorological Bureau of France for the year 1896 have lately been received at the Weather Bureau Library, published as usual in three volumes, of which the first is devoted to special memoirs and the annual report of the president of the Meteorological Council. From the latter it appears that 18 of the provinces of France publish monthly bulletins, and 34 publish annual bulletins relative to meteorology and climatology. There are 2,045 stations for regular observations, or 1 for every 100 square miles of area, and these have furnished 3,348 special thunderstorm bulletins, which latter have been discussed by Fron, who has, for many years, been devoted to thunderstorm work. The number of thunderstorms reported on each day of the year is given in a table on page 38, from which we take the monthly number as given in the second column of the following table:

Months.	Number of days with thunderstorms.			
	France.	Florida.	Louisiana.	Missouri.
January	4	5	7	1
February	5	8	11	3
March	25	6	12	7
April	25	6	10	23
May	31	22	20	26
June	30	29	24	26
July	31	28	24	26
August	30	31	28	25
September	29	26	19	25
October	29	9	10	13
November	14	8	13	8
December	13	1	7	7
Totals for year	266	179	185	190

The area of France may be taken at 204,000 square miles, or about twice as large as either Arizona, Nevada, Colorado, Oregon or Wyoming; but, of course, it would not be proper to divide the above number of thunderstorm days in France by 2 in order to compare its frequency of thunderstorms with those of these respective States. The only States that approach France in the frequency of thunderstorms are Florida, Louisiana, and Missouri, whose areas are, respectively, 59,000, 41,000, and 65,000 square miles. The number of days on which thunderstorms were reported in these States during 1896 are, for the sake of comparison, given in the above table; they are quoted from page 496 of the MONTHLY WEATHER REVIEW for that year. It is difficult to make any proper comparison between France and these States as to the absolute number of thunderstorm days, but it is proper to compare the annual curves of frequency, and to say that the annual distribution of thunderstorms is much more uniform in France throughout the year, and especially from March to October than it is in any region of the same area on this side of the Atlantic.

This first volume contains also a most important memoir by Prof. Marcel Brillouin on the formation of clouds between contiguous layers of winds; a memoir of 100 pages which the present Editor has undertaken to translate entire for the use of observers and students in America. This memoir can not be successfully condensed; every page contains the solution of some important problem. It represents the first successful effort to apply the views of von Helmholtz and von Bezold to the explanation of innumerable cloud forms and even the exact determination of the conditions under which they originate.

A general idea of the contents of the memoir may be obtained from the list of the titles of the chapters: I. Von Bezold's theory of condensation by mixtures. II. Superposed horizontal layers. III. An atmosphere in convective equilibrium; subdivision into zones; geometrical explanation of von Helmholtz's theory. IV. Mixture of contiguous zones of clear air. V. Mixture of contiguous zones of cloudy air. VI. Contiguous zones that occupy the whole height of the atmosphere; condition of the highest regions. VII. Contiguous zones; clouds of invasion. VIII. Two cloudy zones;

clouds of invasion; rain and hail. IX. Unstable conditions. X. Two layers of clouds in the same zone. XI. General circulation.

THE CLIMATE OF ATHENS.

The study of local climatology is not as yet pursued in the United States with that detail and thoroughness that characterizes European memoirs. Although some of our older voluntary observers and many of our Weather Bureau stations have by this time accumulated the necessary data, and although the records for some stations, such as Pike's Peak and Colorado Springs, the Dudley Observatory at Albany, and the Central Park Observatory in New York, have been published *in extenso*, yet there is still wanting a discussion of these observations in all their bearings on meteorology, hygiene, agriculture, navigation, and engineering which shall serve as a model treatise on the climate of some American station. Such a model memoir bearing on the climate of Athens has, however, lately been published by Professor Demetrius Eginitis, Director of the National Observatory, in that city, and forms a part of the first volume of its annals. The handsome typography that distinguishes this volume above the ordinary meteorological publications is eminently appropriate to the classic nature of the subject, for we have here for the first time presented a complete picture of the climate of a region whose history and art, ethnology and science have been familiar to the civilized world from time immemorial. We have now for the first time the data needed to carry out investigations into the possible relations between the climate and the development of mankind and the arts that accompany civilization. This latter study, if there be anything in it, we must leave to others, but the general contents of Eginitis' work on the climate of Athens we may give at length as suggesting what may well be done for many American cities. The technical meteorological records which have been summarized in this volume are those by Peytier in 1833–1835; by Fraas, 1836–1841; by Vouris, 1839–1847; Papadakis, 1853–1857; Schmidt, 1858–1884; Kokkidis, 1884–1889; Eginitis, 1890–1896. Since 1847 most of these observations have been made at the Observatory of Athens and many of them have been published, more or less completely, by private enterprise. In fact, many of the original records, having been purchased by Germany, are now deposited for safe keeping in the fireproof buildings at Potsdam. After a brief description of the present topography of the city and its surroundings, and the changes that have taken place, as shown by quotations from classic authors, the director of the observatory publishes fourteen chapters treating successively of atmospheric pressure, temperature, humidity, wind, rain, snow, hail, dew and frost, haze and fog, cloudiness, thunderstorms, evaporation, optical phenomena, temperature of the soil and the water, and the Arago actinometer. Each of these chapters opens with a charming sketch of the ideas and the knowledge that have come down to us from the ancient Greeks relative to the subject in hand and it would surprise the modern scientist to see how near the truth the ancient philosophers attained in respect to many subjects that have only become clear to us since the days of Galileo and experimental philosophy.

The barometric pressures are given by decades and by months deduced from the thirty-six years, 1858–1893, and the results compared with the isobars of Teisserenc de Bort. The monthly and mean annual pressures are given for each hour of observation, 8 a. m., 2, and 9 p. m., as well as the extreme barometric readings for each month during these fifty-four years. The variability of the climate, as represented by the amplitude of the normal variation of pressure between two consecutive daily readings at 2 p. m., is shown by the study of the last fifteen years. The variability is decidedly less that for Paris or Perpignan. This is contrary to the ordinary opinion that the climate of Athens is more variable than the climate of Paris and it is shown that the reason lies in the fact that the atmospheric variations at Athens are frequent but not very decided, whereas, at Paris they are less frequent but much greater. At Athens the weather varies sometimes in the course of the day and even in a few hours, but these habitual variations are small, whereas, at Paris the same kind of weather lasts for a longer time but the disturbances are ordinarily more extensive than at Athens.

The chapter on temperature treats that subject with even more elaboration, occupying forty pages of the volume, and concludes with data illustrating the variability of the climate, especially by the fact that the same date palms and other plants flourish to-day in the same places and to precisely the same extent that they did in antiquity. This was then, as now, the limiting climate, in which the palm occasionally, but not regularly, ripened its fruit. A change of 1° C. would, apparently, have made an appreciable improvement in the cultivation of this fruit, so that, as the author says, it is not likely that the normal annual temperature has changed by this amount in two thousand or three thousand years.

The observation of the humidity of the air by means of the hair hygrometer began in 1839, and the discussion of this subject occupies twenty-four pages of the third chapter, preceded, as usual, by quotations from Aristotle and other classic authors. The winds and general cloud phenomena could be observed by the ancients as well as by the moderns, and the quotations from classic authors are arranged in the fourth chapter, which occupies about thirty pages, in connection with the author's more elaborate discussion of each phase of this subject, viz, the relation of the winds to clouds, rain, thunderstorms, humidity, temperature, pressure, diurnal and annual frequency. The strongest wind at Athens is from the northeast, next to that, the south, and the feeblest wind is from the east. The maximum force of the south wind during the period of accurate observation has sometimes attained 20 to 30 meters per second, and on the 26th of October, 1852, such a south wind overturned one of the columns of the temple of Jupiter Olympus at Athens.

The rainfall is discussed in the fifth chapter, in about thirty pages of text. Even the ancients understood that rain was in some way produced by the condensation of aqueous vapor from the atmosphere, and knew that the quantity of water which falls upon the neighboring mountains, such as Parnassus and Hymettus, was far greater than that which fell at Athens. Although Athens is subject to very long and severe droughts, yet the actual rainfall for successive decades does not vary very much. The normal number of rainy days in any month varies from 1.5 in August, 2.9 in July, to 13.5 in December. The prognostics of rain at Athens have been observed from classic times. Whenever Hymettus is seen covered with clouds, it is considered very probable that it will rain. This often fails, but it is verified often enough to maintain the belief in its efficacy. The altitude of Hymettus is about 1,027 meters; consequently, when clouds are seen around its summit, these can scarcely be the upper cirrus or the medium cirro-cumulus, but must necessarily be the lower clouds—cumulo-stratus or cumulo-nimbus. Such a mountain must, therefore, be considered as a hygrometer that indicates the altitude and nature of the clouds. The connection between rain and the local topography, on the one hand, and the general meteorology of Europe, on the other, is discussed, with a view to explaining the general conditions that cause rain.

NOTES FROM THE NOVEMBER REPORTS OF THE CLIMATE AND CROP SECTIONS.

ARIZONA.

Mr. W. G. Burns, section director, remarks that—

A period of drought, remarkable, not so much on account of its duration as for its extent, prevailed in Arizona from September 12 to November 18, inclusive. * * * Taking into consideration the varied topography of the Territory, its vast area of 113,000 square miles and its changing meteorological conditions, it is remarkable that this drought prevailed for so long a period.

Arizona lies between the area of high pressure over the Pacific and under the Tropic of Cancer and the corresponding high area over the Atlantic and the Gulf of Mexico. Between these tropical areas (which would probably be continuous belts of high pressure if the earth had a uniform surface of water), the equatorial belt of low pressure intrudes by sending an arm of low pressure along the coast of Central America northward up the Gulf of California into Arizona. The rains that come to Arizona vary with the presence, or absence, of this extension of the equatorial low and if drought prevails in Arizona it is apt to be only a portion of the area of drought extending northward over California.

CALIFORNIA.

The deficiency of precipitation, on the average for 162 stations, was 1.20 inches, or about 55 per cent of the normal, reckoning the latter at 2.20 for the whole State. There seems to have been abundant rainfall in the extreme north, but little or nothing in the southern half and the central valley. This area of drought, therefore, adjoins that in Arizona and southern Nevada, and one common cause must have produced the whole.

Mr. E. L. Coethen communicates some remarks on protection from frost, from which we infer that close wind-breaks at right angles to the flow of cold air cause low temperatures on the upper side. A block of large trees below a block of smaller trees would have the same effect. Fires at these points will drain off the cold air; flowing water is a help, but not sufficient in itself; clean culture and a wet surface are the best conditions of the soil. Firing of any kind is beneficial, if there is enough of it. Twenty to fifty coal baskets per acre will be needed according to the location and size of grove. A little burning straw is a snare and deceit; dry straw is of little value; smudge from wet straw should be dense and cover large areas and be lighted early. Coal baskets should be filled at the start and replenished before the fire is too low, they need less attention than smudge. Oil fires do good work, but the smoke is objectionable. Evaporating pans give no visible results. An awning or cover was found to be of great service in the orchards at Riverside.

FLORIDA.

Mr. A. J. Mitchell, in speaking of the protection of orange groves, says:

Heroic remedies are necessary, and it is very generally conceded that the only measure that promises success is the use of fires supplemented by other forces. Experience has forced the recognition of the importance of dry heat as the only safe recourse when the temperature falls to 20° or below. Many groves are now liberally provided with fuel, deposited at certain intervals and sufficiently near to cause a rise in temperature when ignited. Mr. G. P. Kinney, of Pierson, says that during the winter of 1897-98 he had to keep his fires going for nine nights, which was the longest period during the past five years. He places little piles of fuel between each of his trees and can fire an acre in a few minutes. He found that firing every fourth pile raised the surrounding temperature 5°, and firing every third pile, 7°; by firing all the piles the temperature rose 15°.

The report of the Lake County Horticultural Society gives the result of an experiment made October 15, in partly cleared pine woods, where 30 fires were placed 50 feet apart each way; the thermometers were in the middle of each square and on the leeward of the fires, 5 feet from the ground. The fires were started at 8 p. m. and kept up for three and a half hours; the size of the fires was regulated so as not to injure an orange tree 17 or 18 feet to the leeward. There was very little wind and the dew-point was reached early in the evening. The air temperature was 63° at 8:30 and 60° at 11:45 at a distance from the fires; the average rise of the thermometer was 3.5° to 4°, and a few thermometers, placed 10 feet from the ground, averaged 2° higher still. Two and a third cords of wood were burned, of which one-half was light pine and one-half green pine. This report is one of many that will be made this winter, and every such series of exact experiments and measurements give valuable data for determining what can be done under any given condition.

GEORGIA.

Mr. J. B. Marbury says that the value and development of the peach interest in Georgia has necessitated methods of protection against frost. During the spring of 1898 several damaging frosts occurred, but answers from a number of peach growers showed that the location of the orchards is very important, and that quite a number escaped damage although no protection was used. Without an exception, orchards on high ground fared better than those on low ground; when an orchard extended from the hills down into the valley, little or no damage was done on the hill while trees in the valley had all the fruit killed. Orchards in the lowlands when properly protected by smoke did not suffer. Smoke made from coal tar was used by Mr. John D. Cunningham, who says:

It not only produces a dense smoke but prevents the ravages of the curculio. I left several portions of my orchard unsmoked, and these portions were injured by curculio, the others were not. This is the general testimony of the other cultivators of peaches and plums. In general, nearly all that were thoroughly smudged were saved, while a large percentage of unprotected fruit was lost.

[If the curculio can be thus easily checked, that alone would make it worth while to smudge with coal tar smoke.—ED.]

ILLINOIS.

Mr. Charles E. Linney states that from 201 reports of loss by lightning, during May–October, 1898, in Illinois, he concludes an aggregate loss of $43,000.

A survey of the reports shows a very marked increase in the loss of stock due to the wire fence, and the urgent need of frequent ground wires on those in use; a largely increased loss of barns and granaries during the harvest season, probably due to storage of new grains and grasses; slightly more danger to stock on wet than on dry lands; lack of any marks upon stock in most instances; the general movement of thunderstorms from west or southwest to east and northeast; a very large number of buildings struck but damaged only slightly; and, finally, an area of marked frequency in losses covering the northwest counties especially, and the northern district as a whole, with an apparent absence of losses in central counties.

IOWA.

Mr. J. Russel Sage having, in his summary for October, shown that a large portion of the cattle injured by lightning were at the time standing in close contact with wire fences, and having also shown that by providing these fences with ground wires the loss of live stock may be greatly diminished, the Farmers' Voice of Iowa publishes the following comment upon this improvement by Mr. Sage:

We may scarcely overestimate the importance of investigations of this kind, tending as they do to reduce to the minimum the destruction of life and property by lightning. Properly protected barns and houses, scientifically constructed wire fences, and the many precautions which as a consequence will be taken must result in increased immunity from the blighting effect of this death-dealing element. Farmers everywhere owe Mr. Sage a debt for his timely and intelligent efforts.

Weather forecasts in England are favorably considered by a writer in the London Standard, who says:

The forecasting of our meteorological office in London is based on long observation and an inductive system. * * * The prophets sometimes prophesy falsely, but for this, as we shall see, they are generally not to blame. During the twelve months ending with March, 1898, they were fully successful in 55 per cent, and partially so in 26 per cent; of the remainder only 6 per cent were complete failures. This

81 per cent of verifications is within the range of 79 to 84 that has prevailed during the past ten years. Of the storm warnings nearly 92 per cent were justified. Of the forecasts of rain for the hay harvest season, 90 per cent proved useful. The successes are most numerous on the eastern side of England, and least so in Ireland and the west and north of Scotland. Most of our bad weather comes from the Atlantic and the observers get no intimation of its approach until it is near the western shore. As we live in an island country, with an ocean on the west, we must put up with a changeful climate and occasional failures in weather forecasts.

LOUISIANA.

Mr. Alexander McAdie continues his papers on the formation of frost by one on the methods of fighting frost, and considers especially the great freeze of February, 1895. He says:

On the morning of February 7, 1895, when the temperature was 40° at New Orleans, the forecast was made that, in all probability, a temperature of 15° would be reached by the morning of the 8th. The temperature actually recorded at the time mentioned was 16°, being a fall of 24° in twenty-four hours, and a remarkable verification of the forecast. This is important, because it signifies that warnings can be given sufficiently long in advance to permit of active measures by smudging, screening, warming, or flooding.

The weather map of February 6 may be taken as typical of the conditions preceding heavy frosts or freezing weather. An area of low pressure is found to overlie Louisiana and Mississippi, while over Manitoba an area of high pressure exists. The high area moving rapidly southward brings about a great cooling of the air and the first step in the formation of frost is thus accomplished. To protect successfully, then, every fruit grower must watch the weather map. He should be in communication with the Weather Bureau. He should also provide himself with a reliable thermometer which should be read carefully about 10 o'clock at night whenever conditions are favorable for frost. The thermometer should have a free exposure, and should be read some distance from the house. Two readings should be made, one with the thermometer five feet above the ground and one about six inches from the ground. The bulb of the thermometer should then be dipped in clean water of the same temperature as the air. With the bulb thus wet, the thermometer should be whirled for about three minutes at the end of a string about two feet long. If properly done, the temperature will be found to read several degrees lower than before. This difference between the dry and wet readings is of great importance. In a rough way, by doubling this difference and subtracting it from the dry temperature, one can obtain the dew-point or a temperature a little above it. When the dew-point is below 40°, the fruit grower should remain on guard, take further readings, and begin to light the smudges. For example, if the temperature of the air is 42°, and the wet bulb reading 38°, the difference, 4°, doubled and subtracted from 42°, gives the dew-point as 34°. This rule holds where the differences are small as, in general, they are likely to be in Louisiana. These instructions are intended for those who have but one thermometer. For those who have sling psychrometers, more specific instructions are available.

Having thus forewarned himself, as it were, of the approach of frost, the fruit grower is ready to consider the ways by which the injurious effects of frost can be counteracted. It will be well to study natural conditions preventing frost. We find that on dates when frost was expected but did not occur, one of several conditions occurred. Either strong northerly or northwesterly winds blew during the night and thus thoroughly mixed the air, preventing the formation of pools of stagnant cold air; or there were moderate southerly or southeasterly winds, warm and laden with moisture; or the night was cloudy or foggy. In brief, the natural preventives of frost are thorough mixing, warming, adding moisture, and screening.

Mr. McAdie then gives some account of artificial methods of protecting against frost and, especially, brings before the notice of the planters in Louisiana some of the results of the work done in California under the stimulus of Mr. Hammon, whose newest bulletin on the subject is now in press.

MARYLAND AND DELAWARE.

Mr. F. J. Walz gives an outline of the plan to be followed by the Maryland and Delaware section in the climatic studies that are now in progress. The plan of work includes the history of local climatology, the description of instruments and the general characteristics of weather and climate. Also, the fullest details as to temperature, precipitation, humidity, cloudiness and winds.

MISSISSIPPI.

Mr. W. T. Blythe very properly says:

The record of unusual phenomena made by some observers, under the head of "Remarks" on their monthly reports is highly appreciated and enhances the value of their work in cooperation with the Weather Bureau. Special value attaches to their statements concerning the crops and the weather. There is no better agency than the monthly Section Reports through which to make known to the world the climatic features of the State and its agricultural possibilities.

MONTANA.

Mr. E. J. Glass states that the weather for the month of November is generally characterized by a cold wave which heralds the first approach of winter. During the present November, this cold period occurred on the 19th at nearly all stations in Montana and lasted for several days, the coldest temperatures were reported on the 21st. The maximum of 4° on the 19th at Glendive was 45° below the maximum on the day preceding. Only three stations escaped the cold wave on the 19th, and these were situated in the extreme western portion of the State. The warmest part of the State was that west of the Rocky Mountain Divide, and the coldest was the extreme northeastern portion. (This accords with the general experience that the cold air flowing from the north southward keeps to the lowlands). At Glendive, the Yellowstone River froze on the 21st, five days earlier than any previous record. At Missoula, on the evenings of the 29th and 30th, the wind was blowing a gale from the east out of Hellgate Canyon while clouds, at about 1,000 feet altitude, were going in an opposite direction from the surface winds. Such a phenomenon as this must stimulate local meteorologists to determine the cause of this lower opposite current. If it were 10,000 feet deep, then, one might conclude that the westerly wind striking the main divide at the head of the canyon deflected downward; but the mountain tops are not high enough above Missoula to justify this explanation. More likely, the lower current was due to the cooling of the air in contact with the sides of the canyon and was, therefore, of very moderate depth, perhaps 1,000 feet, a depth that could have been determined by flying a kite or by climbing up the sides of the canyon. If this be the true explanation, then an explorer with a sling thermometer should find the temperature of the air slightly warmer at great heights than in the valley below, showing that the lower or eastern wind is simply the underflow of cold air down the valley. If, however, the temperature grows colder with ascent, then the question would, primarily be, whether it diminishes according to the adiabatic rate of 1° F. for 183 feet.

NEBRASKA.

Mr. G. A. Loveland republishes an excellent article on snow crystals by G. H. Perkins of the University of Vermont, that first appeared in Appleton's Popular Science Monthly for May, 1898. The Editor hopes to present a summary of some of Mr. Perkins' conclusions in a future number of the MONTHLY WEATHER REVIEW. It is a matter of regret that the Weather Bureau observers have not as full access to scientific periodicals as their needs require. The Chief of the Weather Bureau has arranged to have a few scientific journals circulated among the stations, but much more is desirable in this direction. Of late years Appleton's Popular Scientific Monthly has contained numerous popular and instructive articles on matters pertaining to meteorology, climatology, and physical geography. Among these we note the following titles in Vol. LIII, June to October, 1898: Page 307, "Prindle on weather forecasts;" page 467, F. W. Felch, "The aurora;" page 48, G. J. Varney, "Kite-flying in 1897;" page 75, G. H. Perkins and W. A. Bentley, a "Study of snow crystals;" page 577, G. W. Spencer, "Geological waterways across Central America;" page 789, F. L. Oswald, "Weather

freaks of the West Indies." Besides these meteorological articles are numerous others relating to allied branches of science.

NEVADA.

Mr. R. F. Young publishes some interesting remarks by Mr. Daniel Bonelli, illustrating the climate and crops of southern Nevada, who says:

This region is very different from the distinctly Northern States in that our growing season is longer by several months than in other portions of the State. We usually have no frost here until in November, and our last crop of alfalfa, usually the sixth, and sometimes the seventh, is not cut until the end of November, and sometimes just before Christmas.

The drought affecting southern California and Arizona has also prevailed over southern and northwestern Nevada.

NEW ENGLAND.

Considerable space is given by Mr. J. W. Smith to the great storm of the 26–27th, which "dwarfs all other meteorological features of the month." The estimated maximum wind velocity at Block Island was 97 miles by the Robinson anemometer, but of course, the individual gusts must have been more severe. Not in the history of the present generation has there been such a record of devastation and death on the coast of New England.

NORTH CAROLINA.

An earthquake shock was reported on November 25, as follows: Mount Pleasant, 3:10 p. m.; Abshers, about 3 p. m.; Charlotte, 3:05 p. m.

SOUTH CAROLINA.

Mr. J. W. Bauer has started a little investigation in order to ascertain what effect the weather has on colds, or what weather conditions are most favorable for catching cold. He finds that there is a direct relation between both the inception of colds and the increased severity of standing cases and an abnormal or unusually wide range of daily temperatures. The coughing spells of persons afflicted with a cold were generally more severe after sunset when there was a rapid lowering of temperature, unless the persons were in a very warm room during that time, or were taking active exercise out of doors. If persons are more liable to catch cold when the daily range of temperature is abnormally wide, then the weather forecasts will take on a new value. It occurs to the Editor that, in the coldest part of the day, the temperature is apt to fall so near to the dew-point that the particles of dust floating about become coated with moisture, and settle so rapidly toward the ground that when we go out of doors, we breathe in an unusually great number of irritating cold particles of moisture and, possibly, even the germs of disease. The irritation that produces a cough may be due quite as much to the cold particles that are caught by the lungs as to the cold air itself. Will not some of our observers, regular and voluntary, try the experiment of breathing the cold air in through a handkerchief, or some better form of respirator, arranged to catch the dust and fog but allow the clean air to pass through.

TENNESSEE.

The observer at Madison, in Davidson County, reports:

On the night of the 14th, many extremely brilliant meteors were observed, completely traversing the heavens from northeast to southwest; as many as six were visible at one time; many were so brilliant that objects could be seen fifty yards away as readily as by moonlight. This shower of meteors lasted from 8:15 p. m. of the 14th to 12:20 a. m. of the 15th.

Although several observers have reported individual bright meteors during November, yet this is the first notice that we have seen of anything like a shower of meteors. Such showers are pretty sure to occur somewhere on the earth during November 10–14 every year, and although these shooting stars are of little importance to meteorologists, yet the astronomers are sufficiently interested in them to issue instructions for the guidance of those who desire to make useful observations.

UTAH.

Mr. J. H. Smith, section director, expresses the pleasure it gives him to issue the first number of the report for Utah in the standard printed page. We believe this, therefore, celebrates the disappearance of publications by the milleograph process. This process was invented by the officials of the Weather Bureau less than ten years ago at a time when some method of publication was imperatively called for, but when the ordinary printing press was supposed to be too expensive a luxury. But time has shown that the Bureau can not afford to publish its valuable records in any temporary or imperfect manner. Newspapers, carbon or manifold copies, the mimeograph, the milleograph, and even the lithograph methods are apt to be regarded as fit only for temporary use. It is, at the present time, impossible to obtain many complete sets of these early publications of the Weather Bureau. On the other hand, the present printed quarto monthly reports can be bound into handsome volumes, and will a century hence be available for studies in climatology. Few of us can realize the numerous and novel uses that will hereafter be made of our published climatological data.

VIRGINIA.

The Editor takes the liberty of repeating his former words appreciative of the good taste shown in the colors of the base map printed in the reports of the Virginia section. Most of the section reports show the base map in blue and the isobars and isotherms in red, a few give both in black, but Mr. Evans has chosen old gold for the base, and a blue-black for the meteorological lines. Harmonious combinations of colors are always to be preferred. Good taste is as conspicuous on the printed page as anywhere else.

WISCONSIN.

Mr. W. M. Wilson, section director, reprints an excellent article from the Milwaukee Sentinel, describing the weather service in the West Indies. In this article Professor Moore states that the present Secretary of Agriculture, Mr. James Wilson, instructed him to increase the usefulness of the Weather Bureau as much as possible, and, especially, to extend its benefits as far as possible to those sections of the country that have heretofore been neglected. It was Secretary Wilson who conceived the idea of extending the weather service of the United States over the islands in the Gulf of Mexico and the Caribbean Sea. In less than one month from the time that Congress authorized the extension, twelve observers were sent to as many islands in the West Indies, the stations were fully equipped, the meteorological apparatus set up and arrangements made for cabling observations to Kingston and to Washington twice daily. Our observers had scarcely reached their stations when the most destructive hurricane since 1860 began to form to the southeast of the island of Barbadoes.

WYOMING.

Mr. W. S. Palmer, section director, gives a suggestive table, showing the mean temperature for the whole State and for each November from 1891 to 1898; also, the average precipitation over the whole State, year by year. The normal, or average for eight years, is, temperature, 31° F., and precipitation, 0.76 inches. But the point to which we wish to call attention is not mentioned by him, viz, that the years of higher temperature are, also, years of small precipitation, and the years of low temperature have rather large precipitation.

By rearranging Mr. Palmer's table in the order of temperatures, we get the following result:

Year.	Temperature.	Precipitation.
	°	*Inches.*
1896	24	1.06
1898	28	0.83
1895	30	1.30
1893	31	0.79
1891	33	0.60
1897	33	0.68
1892	35	0.50
1894	37	0.28
1895.5	28.2	0.97
1893.5	34.5	0.52

By averaging the first four and the last four years, we get values for the two groups, as shown in the last two lines of this table; and there can be no doubt but what there is a definite relation between the average November temperature and the total November rainfall. Similar relations exist for nearly all parts of the globe. A large precipitation generally means a proportionately large amount of cloudiness and, therefore, a small amount of sunshine. There are, however, some regions where the heat received from the sun during clear weather is so small that a continuous cloudy layer, acting as a blanket to prevent radiation, maintains a higher temperature while at the same time giving more precipitation.

NOTES FROM THE DECEMBER REPORTS OF THE CLIMATE AND CROP SECTIONS.

ALABAMA.

Mr. F. P. Chaffee notes that during a severe hailstorm at Montgomery on December 2, lasting about four minutes, there was no unusual change either in temperature or pressure, such as usually accompany the fall of hail during the summer season. The rapid oscillations of the barometer during hailstorms, as shown by a barograph record, are not yet completely explained. Doubtless, in many cases a satisfactory explanation can be given, but not in other cases. A comparative study of the hailstorms without barometric fluctuations, as compared with those that show such, would doubtless be very instructive.

ARIZONA.

Mr. W. G. Burns notes that the month has been remarkable for the general severity of the weather, the average deficiency of temperature was nearly 5°, a snowstorm prevailed on the 9th and 10th, over three-fourths of the Territory, and the fall amounted to nearly 30 inches at some mountain stations. But notwithstanding this unusual phenomenon the citrus fruit did not seem to have suffered any injury. It is hard to believe that such unusual weather in Arizona may not be followed by similar unusual cold and snow over the regions to the eastward. Thus, we notice that in New Mexico the month has also been very cold, the average for the State being below the normal with an unusual amount of snow in the mountains. Arkansas shows 3.9° below the normal, but the average rain and melted snow was not above but rather below the normal. Louisiana gave a temperature of 5.2° below the normal, but the precipitation was also below. In general, therefore, as we proceed eastward from Arizona, the temperature was uniformly below the normal, but the excess of rain and snow which prevailed in the Rocky Mountain region, disappears as we approach the Mississippi River and enter the region where low temperatures are produced by the southward flow of the cold, dry northers. This antithesis between cold, wet weather on the west, and cold, dry on the east is but an ordinary case illustrating the great variety of combinations that occur in climatology.

CALIFORNIA.

The report for December prints quite an extensive memoir by Dr. Marsden Manson, on the laws of climatic evolution. This is a problem that has always interested the geologist, but has, of course, very little to do with the practical problems of modern meteorology. As a rule we must utilize our knowledge of present conditions in order to throw light upon the nature of the climates that prevailed in past ages, and we can scarcely utilize the latter in studying current climatology. As Mr. Manson's memoir will, probably, be published in the Proceedings of the British Association for the Advancement of Science, it will, doubtless, attract the attention of the geologists who are especially interested in it, and who, if we mistake not, have already taken into consideration the special ideas that Mr. Manson has dwelt upon. The same mail brings us the latest discussion of this subject by Lord Kelvin in a pamphlet entitled The Age of the Earth, published by the Victoria Institute in London. The study of this pamphlet shows us that, even after making the most generous allowances, the subject is still beyond our grasp. The exact scientific work of the last century has not yet afforded a sufficiently secure basis for argument as to what was the temperature of the earth's crust, or the condition of the earth's atmosphere millions of years ago. Still men must attempt to reply to the questions that crowd upon us when we study geology and paleontology. It becomes evident that there must have been some form of climatic evolution, but the best theories that we can elaborate to-day are liable to be upset to-morrow, because they have involved so many assumptions and must give place to facts when these have been established by the general progress of knowledge. We would not discourage scientific speculations as they play an important part in stimulating the search for facts to support them; but when facts and principles are once well established, *these* constitute science, and the speculations with which they did not harmonize, give place to something else nearer the truth.

COLORADO.

With regard to snow in the mountains, Mr. F. H. Brandenburg says:

> While it is true that more snow usually falls after January 1 than before that date, agriculturists of Colorado and abutting territory attach great importance to the amount received early in the winter, for these snows solidify, and consequently do not melt until late in the season, thus furnishing a water supply after the snows of spring have melted and passed off.

He adds that during December the snowfall has been very large, the temperature low, and the winds high. These are the conditions that usually go together in mountainous countries. He ventures general predictions as to the amount of water that will be available for irrigation during the summer season of 1899, which we condense as follows:

> Arkansas watershed: the flow will be much greater than in 1898, and of longer duration. South Platte watershed: the flow will be much greater than for a number of years, and be prolonged beyond the usual time. Rio Grande watershed: a heavy and prolonged flow. Gunnison watershed: the flow will be very close to the normal. Grand watershed: prolonged and plentiful water supply.

GEORGIA.

Mr. J. B. Marbury publishes a detailed letter from Mr. T. O. Skellie, who maintains that the failures in the peach crop have been generally due to frost, and can be prevented by a proper attention to frost protection, either by smudges or by any other practicable means.

We ought to learn from our successes and failures between 1890 and and 1898, that nature will not do all the work, but if given a little help in the right manner and at the right time, she will make a grand success of her work.

We could not have a better illustration of the general principle that the crops raised by human labor and care are so largely dependent upon the intelligence of man that it is almost impossible, by the study of statistics, to demonstrate the influence of the climate as such.

ILLINOIS.

Mr. C. E. Linney states that, as regards the protection of winter wheat by snow there are conflicting reports during the present season. It seems that the snow afforded little protection, and the greater warmth of the southern half of the State gave opportunity for some damage by freezing and thawing. However, both of the spells of very cold weather were preceded by snowfalls of from 1 to 3 inches, thereby affording some protection.

In general, it has been long since recognized that a freshly sown plowed field is greatly affected by freezing and thawing, and that a continuous covering of snow is the best condition for winter wheat. Many measurements have been made of the temperature within and above the snow covering. Prof. A. Woeikof has collected a great deal of data on this subject in his memoir on the influence of the snow covering the ground, on the soil, the climate, and the weather. There are many cases in which the soil may be 20° or 30° warmer than the air at the surface of the snow. The influence of the snow in protecting the soil from cold is greater in proportion as the snow itself is lighter and drier. Woeikof proposes many items of experimental and observational research bearing upon practical matters that affect the crops, the railroads, and the work of the meteorological bureaus in Russia, Canada, and the United States. The general importance of this subject is so thoroughly appreciated in the United States that we may, with confidence, expect many of our own observers to make measurements of the temperature above and below the snow daily, so that we may have a more definite idea of the total amount of protection afforded by the snow in each of the winter months. Some of the agricultural experiment stations have already given attention to this subject, and would, doubtless, welcome the cooperation of our voluntary observers.

IOWA.

Mr. J. R. Sage quotes from Science a paragraph to the effect that the Southern Pacific Railroad Company has supplied 181 of its stations with an outfit of meteorological instruments, and that weekly crop reports are forwarded from 52 of these. There are doubtless many other railroads that would further the best interests of the farmers within their territory, and, eventually, their own best interests by encouraging the regular returns of rainfall, temperature, wind, and sunshine, as being the elements that most directly affect the farmers.

The phenomenal rain which deluged Des Moines County, Iowa, on the morning of August 6, 1898, is the subject of a special article by Mr. M. Ricker. The readers of the MONTHLY WEATHER REVIEW will perhaps be surprised to find no mention of this cloud-burst in the text of the REVIEW for that month; but this is explained by the smallness of the area over which the phenomenal fall occurred. However, they will find confirmatory evidence of the torrential fall in Table XI, page 388, and additional particulars are furnished in the following paragraphs by Mr. A. J. Henry.

A measurement of the rainfall caught by a standard rain gauge during the storm in question was made by Mr. G. W. Scofield, voluntary observer, United States Weather Bureau, whose station is about 7 miles north of the boundary line between Des Moines and Louisa counties. Mr. Scofield recorded 5.16 inches as falling during the night of the 15th and up to 9 a. m. of the 16th. At Wilton Junction about 35 miles north of Des Moines County, Mr. J. M. Rider, voluntary observer, recorded 4.38 inches as falling between 10 p. m. of the 15th and 8 a. m. of the 16th. The fall at other points to the northward and northeastward of Des Moines County was heavy, but not uniformly so. The Weather Bureau station at Davenport recorded 2.25 inches; Dr. Luke Roberts, voluntary observer at Clinton (about 70 miles northeast of Des Moines), 3.01 inches.

Mr. J. M. Brown, division engineer of the Burlington, Cedar Rapids and Northern Railway, reported as follows:

On the morning of Tuesday, August 16, 1898, an unprecedented rainfall occurred in Des Moines County, Iowa.

It "washed out" several miles of track of this company from Burlington north, along a small creek called Doy Branch, and its effect was noted most on this stream and Flint River, a small stream on the north edge of Burlington, also Hawkeye Creek passing through the city of Burlington and being partly sewered by the city.

I have secured records of this rainfall varying between 9.25 and 16 inches, each person giving the record being quite sure he was correct. The records are as follows: Two of 9.25; one of 14 and one, 16 inches. From the rise in the streams I am inclined to believe 10 or 12 inches of water fell. The duration of the storm was from 3 a. m. to 7 a. m.

According to Mr. Ricker's account the area of haavy rainfall was bounded on the west by the Des Moines County line (this county is in the southeastern corner of the State and includes the city of Burlington, Iowa), on the north by the northern edge of the county, on the east by the Mississippi River, and on the south by the Flint River, which runs southeastward centrally through the county. Therefore, the area of heavy rain may be roughly described as the northern two-thirds of the county, or approximately 250 square miles. There seems to have been no regular rain gauge in Des Moines County at that time, but various measurements of the rain caught in tanks, cans, buckets, etc., lead to the conclusion that, at least sixteen inches of water fell in three hours, over an area of 50 square miles and great damage was done by the resulting flood of water. Mr. Ricker states that the map for that date shows a low pressure area reaching into Iowa, but would not warrant a forecast of general rain and that the energy liberated by such a heavy fall of rain would form an interesting study. He adds that the heaviest rainfall that has come to his notice was 15 inches at Wilmington, Del., on the 29th of July, 1839.

The Editor can not too strongly urge the importance of such studies as these upon local rains and similar phenomena. The 2,500 rain gauges that report regularly to the Weather Bureau can only give a general view of the distribution of rain and must frequently fail to record these local cloud-bursts over regions of five or ten miles in diameter. Every county that is without one or more rain gauges fails to have its climatological peculiarities properly recorded. Certain classes of our citizens, such as the engineers and the river men should interest themselves in seeing that a sufficient number of rain gauges are placed in good hands over every State and every river watershed. Other classes, such as the physicians and the farmers may be expected to look after observations of temperature and sunshine. The August cloud-burst of Des Moines County, with a local rainfall of 16 inches in three hours must go on record as one of the most intense rainfalls that has yet been observed.

LOUISIANA.

Mr. Alexander G. McAdie continues his excellent articles on frost and frost protection. He says:

Of all the methods proposed for the protection of fruit, irrigation is perhaps the best. It has been tried in many portions of the country with different fruits and vegetables, and has generally given satisfaction. Cranberry growers have proven the positive value of flooding the marshes at time of frost. In the arid and subarid regions, where

water is not over-plentiful, there may be some objection to the too free use of water; but in Louisiana, with abundance of water, irrigation would seem to be an ideal method of protecting. * * * The climatic conditions of Louisiana differ from those of California, so that methods adopted in the latter State must be modified in order to obtain the best results.

Possibly we ought to go still further, and say that the soil and the plants must also be considered; so that, in general, a given climate will not produce the best crop except for a specific variety of soil and seed. Most of the labor that has been spent in determining a definite relation between climates and crops has assumed that the soil conditions were alike in different fields, and the results are, therefore, not applicable to other localities having different soils.

MARYLAND AND DELAWARE.

Mr. F. J. Walz publishes an interesting contribution by Mr. O. L. Fassig on ancient weather records in Maryland. He has been so fortunate as to discover records kept by Dr. Richard Brooke in 1753–1757, and probably a longer record by him may still exist in manuscript. According to Dr. Brooke's record, a severe drought prevailed during July, August, and September, 1755, and again in the same months in 1756. The great earthquake of Tuesday, November 18, 1755, was felt severely. Cold waves, with high winds, are recorded for December, 1755, and January, 1757. A local storm, in which both rain and wind were very heavy, occurred on the 22d of June, 1766. It appears to have passed over every county in Maryland, Virginia, Pennsylvania, New Jersey, and New York, and was, therefore, probably not a single tornado or cloud-burst, as we should have thought if we had had only the record of one station.

This search after old weather records should be encouraged by every section director. The Editor would call attention to the fact that the most important series of papers relating to the early explorations of America, viz, The Jesuit Relations, are now being reprinted by an enterprising firm in Cleveland, Ohio, and copies will undoubtedly be found in all the large libraries. If some one would summarize the meteorological information contained in these early records, it would form a very interesting addition to our knowledge.

MICHIGAN.

Mr. C. F. Schneider calls attention to the remarkable ice blockade which continued from December 8 until the 20th at the west end of Lake Erie. The blockade was broken by the combined efforts of tugs, ferryboats, and steamers, and when the imprisoned fleet was set free navigation closed for the season.

In commenting upon the West Indian Climate and Crop Service, Mr. Schneider quotes the value of the cuerda, as given erroneously in a note in the translation of the first weekly bulletin from Porto Rico, although the correct value was given in the second bulletin. The cuerda is a measure of area very little less than one English acre. It seems to be peculiar to Porto Rico, for certainly the word does not appear in any ordinary Spanish dictionary in the same sense in which it is used in Porto Rico, where it designates a field that is 75 Spanish varas square. But, as the vara has different values, it will be necessary to make a special study of the vara, as used in Porto Rico, before giving a more exact comparison between the cuerda and the acre.

In quoting Dr. Kedzie's investigations into the relations between meteorology and forestry in Michigan, Mr. Schneider especially quotes some observations that show that the total evaporation in an hour from a piece of Turkish toweling kept thoroughly wet, and exposed in a wind of 12 miles per hour, is four times greater than when hung in still air, and the same ratio held good on different days. The Editor would call the attention of our observers to some remarks on page 376 of his Treatise on Meteorological Apparatus and Methods, published as part 2 of the Annual Report of the Chief Signal Officer for 1887.

Owing to the small mass involved in the temperature observations by the wet-bulb thermometer, that instrument is adapted to give the momentary condition of the atmosphere. On the other hand, the large masses required in the measuring operations of the evaporometer renders this instrument important to meteorologists as a means of ascertaining the average hygrometric condition of the air during a long interval. From this point of view, therefore, this becomes an integrating hygrometer, and demands a more minute theoretical investigation than has as yet been given to it.

The report by Professor Kedzie above referred to is a part of a very practical bulletin on forestry in Michigan. Dr. Kedzie's first paragraph, "The controlling influence of climate over forest growth is well recognized," illustrates the tone of the whole article. The author is not studying the infinitesimal influence of forests on climate, but the immense influence of climate on forests. The Editor had the privilege of keeping the meteorological record at the State Agricultural College at Lansing during a portion of 1859, and he knows of no place where the mutual relations of climatology and forestry can be studied better than at Lansing, Mich.

MONTANA.

Mr. E. J. Glass, in an article on the use of the aneroid barometer for determining altitudes, gives us a table of numbers or divisors. When the aneroid has been read at upper and lower stations, and the temperatures are also known, the corresponding divisor is to be taken from Mr. Glass's table; the difference between the two observed pressures being used as the dividend, the quotient becomes the required difference of height in feet. For the sake of those who have many field computations to make, and do not wish to be bothered with a table of logarithms, the Editor prepared a small table, according to the formula of Babinet, which is published as Table No. 32, in recent editions of the Smithsonian Meteorological Tables. The method is as follows: Given the barometric pressures, B and b, at the lower and upper stations, respectively, and the mean temperature of the air between these stations, T, we take from the following table the factor, C.

T.	C.
° *F.*	*Feet.*
10	49 928
15	50 511
20	51 094
25	51 677
30	52 261
35	52 844
40	53 428
45	54 011
50	54 595
55	55 178
60	55 761
65	56 344
70	56 927
75	57 511
80	58 094
85	58 677
90	59 260
95	59 844
100	60 427

The factor thus obtained, is to be multiplied by the difference in the pressures $B - b$, and the product divided by the sum of the pressures $B + b$; the result is the desired altitude of the upper above the lower station. Written algebraically, we have—

$$Z = C\frac{B - b}{B + b}$$

The computations are made much more easily by the aid of logarithms. The pressures must be known to within 0.001 inch, if the height is required to within one foot.

NEBRASKA.

Mr. Geo. A. Loveland urges the importance of full and accurate records, that, for instance, the record of a trace, and the zero figure when no rain or snow has fallen, should not be omitted. He adds:

In recent conversations with some of the observers it has been discovered that they observe and record on the retained copy of the report many interesting facts which are not entered on the copies sent to this office for the reason that the form does not specifically call for this data, and it was therefore assumed that this character of data was not desired. This is a mistake.

NEVADA.

Mr. R. F. Young says:

The constantly increasing interest in, and demand for, the publications of the Nevada Climate and Crop Service is sufficient evidence of the value of this work to the State and emphasizes the importance of having complete and accurate reports. During the past year more than one hundred of the public-spirited citizens of Nevada have contributed to the success of the work, and it is desired to enlist the cooperation of as many more during the present year.

OHIO.

Mr. J. Warren Smith explains his method of distributing forecasts throughout the city of Columbus, Ohio, by the utilization of the street cars. He states that it has met with such favor that he wishes to commend it to all forecast distributors. A bundle of forecast cards is handed to the conductor of the first car that passes the Weather Bureau office on its way toward the general office of the street railway company. There the bundle is handed in and placed where each conductor, as he goes to the window to make his trip report, can get a card, which is immediately posted in his car. The cards are thus displayed all the afternoon and evening, and give the forecast for the coming night and following day. On his last trip the conductor removes and destroys the card. Both the public and the press of this city unite in saying that for prompt, intelligent, and wide distribution of the forecasts and warnings this plan is one of the best. The plan is rapidly being adopted, also, by the trolley cars in the suburbs of Columbus. The Grove City Railway Company has attached small weather signal flags to the trolley rope, and finds this very satisfactory. Mr. Smith suggests that either flags or tin symbols on a short staff on one corner of the cars be set up. The old system of signals on the steam cars has been discontinued, but those on the electric cars appear to be effective.

OREGON.

Mr. B. S. Pague, in his general review of the month, states that the area of high pressure which descends upon Oregon from the north brings the coldest weather of the month, while the area of high pressure that approaches from the southwest brings the highest temperature. The "north high," as is the usual custom, was marked by almost an entire absence of dynamic heating west of the Rocky Mountains. Continued low temperatures and fair weather prevailed until this high began to dissipate. The highs moving from the north obstruct the eastward movement of the lows and keep them at a distance off the coast, thus preventing precipitation or dynamic heating or chinook winds, which are only possible in Oregon when the area of high pressure is central about southern Utah and the low area is passing eastward on or about the fiftieth parallel of north latitude.

The explanation of the foehn, first given by Professor Hann, is put very clearly by Mr. Pague, thus:

The highs from the north contain little moisture, while those from the southwest are heavily laden. Moist air expands during its rise up the side of a mountain, and is then again compressed in its descent without having any heat added or withdrawn. Furthermore, if the expansion and subsequent compression take place without the precipitation of moisture, the air will reach the same level on the leeward side of the mountain at the same temperature it had at the corresponding level on the windward side. When precipitation has occurred the air will reach the summit of the mountain at a higher temperature than before, and continuing in its descent, the original level will be reached with a higher temperature than at the starting point and the air will be much drier, and these conditions will be more marked in proportion as the original mass of air is warm and moist or cold and dry.

SOUTH CAROLINA.

Mr. J. W. Bauer records the death of one of the oldest meteorological observers in the country, whose service has extended over fifty years. Mr. Thomas P. Ravenel, of Pinopolis, Berkeley County, died on December 19, 1898. The published volumes of rainfall and temperature, by the Smithsonian Institution, credit Mr. Thomas P. Ravenel with records of rainfall and temperature from January, 1846, to March, 1861, at St. John, S. C. The work of the State weather service in South Carolina began in 1887, and Mr. Ravenel is credited by it with records from May, 1893, to December, 1898, at Pinopolis, Berkeley Co. We know nothing of his record from 1861 to 1893, but are encouraged by Mr. Bauer's brief note to hope that such records exist and may be presented by his family for preservation in scientific archives. The Smithsonian volume on rainfall also mentions the record of Mr. H. W. Ravenel, from 1854 to 1874, at Aiken, S. C. It is to be hoped that a family which has contributed two such excellent records will contribute still further to the climatology of South Carolina.

UTAH.

Mr. J. H. Smith reports that the temperature and rainfall throughout the State have been below the normal. If we rearrange the data for December, as given in the December report, we have the following figures:

Average for the State.

Year.	Mean temperature.	Precipitation.
	°	*Inches.*
1893	31.1	1.30
1896	31.0	0.46
1894	26.3	1.94
1898	23.3	0.64
1897	22.7	1.16
1895	21.0	0.78
1893, 96	31.05	0 88
1894, 98	24.80	1.29
1897, 95	21.85	0.97

The last three lines present the average of the successive pairs of the preceding lines.

Evidently, therefore, the central portion of the Rocky Mountain region is already to the east of those regions in which a lower temperature and an increased rainfall go together. The most remarkable phenomena of the month seem to have been the heavy anticyclonic winds of the 8th and 9th. At Ogden, these attained about 1 a. m. the severity of a destructive gale and continued all day long. At this time an extensive area of high pressure was advancing southward over Montana and Wyoming toward a great depression on the coast of Mexico and the peninsula of California.

WISCONSIN.

Mr. W. M. Wilson gives an interesting comparison of precipitation for December during the past twenty-five years. In general, the current month has given a very low temperature and light precipitation. This, of course, is the characteristic winter climate of regions subject to the prevalence of the cold, dry, clear weather that accompanies these areas of high pressure. At Manitowoc the record kept by Mr. Lups continuously since 1863 shows that December, 1898, had the lightest precipitation of all, and December, 1890, had slightly more. Similar results are given for Beloit and Duluth. At Milwaukee the total precipitation for the month was a few

hundredths more than in December, 1872 and 1890. Owing to the difficulty of measuring snowfall with the requisite accuracy, we may, in general, say that the Decembers of 1872, 1881, 1890, 1896, and 1898 must have been very much alike as regards the dearth of snow.

WYOMING.

Mr. W. S. Palmer finds that, as in most other States, Wyoming has had lower temperatures than the average, but not a remarkably low precipitation. If we arrange the data given by him, according to temperatures, we have the following December values:

Year.	Temperature.	Precipitation.
	°	*Inch.*
1896	32	0.10
1893	28	0.90
1891	26	0.82
1894	24	0.57
1895	23	0.45
1892	21	0.99
1897	20	0.91
1898	17	0.64
Average.	27.5	0.60
	20.2	0.75

This table shows a slight tendency toward an increase of precipitation in proportion as the temperature is lower. The small rate 0.02 for each degree of temperature is, however, affected by a large range of uncertainty, but we are probably justified in considering Wyoming as belonging to the eastern boundary of the region that extends eastward from the Pacific coast and over which low temperatures and increased rainfalls go together. To the east of this boundary we undoubtedly come upon the lower plains where in the winter season low temperatures and diminished precipitation naturally go together.

ASTRONOMY FOR THE METEOROLOGIST.

Under date of December 19, Mr. George Ling, observer, Weather Bureau, at Havre, Mont., writes:

An observer astronomically inclined is compensated for his early rising at this season by the sublime spectacle afforded by the heavens. The brilliancy of the planet Venus is supreme and presents a grand sight. This morning at 8:10 a. m. (seventy-fifth meridian time) Venus appeared in the southeast unusually large and bright, the reflection of her light from some ks. clouds passing by resembled that of the moon coming from behind a cloud, and soon afterwards a faint corona showed around the planet. I could see Venus after the sun was up, and it was easily seen by the naked eye when the sun was three degrees high.

Farther in the west was Jupiter, in Virgo, shining conspicuously, and still farther west was Mars, in Cancer, looming up bright and red. Each planet shone very large and bright in comparison with the stars. Orion was setting in the west, and his first-magnitude star, Betelgeuze, stood out prominent in the western sky. Castor, of the Twins; Cancer, with its Beehive, and now decorated by Mars; Regulus, in the Sickle; the triangle formed by Arcturus, Denebola, and Spica; Capella and the Kids; the Dipper, with its "pointers" showing the way to the north Polar Star, all added to the splendor of the scene. Here and there a shooting star flashed in sight, but soon all was obliterated as the circle of illumination rose higher and higher.

Mr. Ling's beautiful description of the starry skies encourages us to hope that he will prepare for the careful observation of the meteoric showers, that interest both astronomers and meteorologists; and why may not others do so, also?

ELECTRICAL DISTRICTS.

Referring to the MONTHLY WEATHER REVIEW for August, 1897, page 352, the Editor has been informed that the town of Sparta, White County, Tennessee, is especially subject to thunderstorms and injurious lightning, which is popularly supposed to be the result of peculiarities in its location. It is situated on the east side of a small stream and on a bluff or hill, considerably higher than the land on the western side of the stream. It is said that the strong winds bringing thunderstorms from the west strike the city on the bluff with great force, that the thunderstorms themselves are much more severe than over the lowlands opposite, and that the danger from injurious lightning is much greater.

No statistics are at hand to confirm this popular belief, but if any exist we should be glad to publish them. On general principles, however, the Editor inclines to the opinion that the popular belief may very likely prove to have but little foundation in fact. Doubtless there are facts that argue both for and against it.

ORIGIN OF THE WORD "BLIZZARD."

According to an article in the Weekly Record, published at Sturgis, South Dakota, January 6, 1899, the word "blizzard" was in use at least as early as 1867. In that year the Hutchinson County Herald gives an account of the blizzard that suddenly approached the town of Vermilion, calling it by that name as one in common use when applied to a sudden change from warm and balmy weather to a blinding snow with cold northwest winds.

The old settlers of South Dakota take exception to the statement that the word "blizzard" originated with a Chicago newspaper, The Advance, on the 8th of January, 1880.

SEISMIC NOISES.

In a letter received long since from Mr. John H. Eadie of Bayonne, N. J., he offered an ingenious explanation as to the origin of the seismic noises frequently heard without any appreciable earthquake shock, viz, that their origin is similar to that of the noises heard in steam-heating apparatus. As is well known, these are caused by the concussion between two masses of water coming together with considerable speed in a space that is almost entirely vacuous. The steam that should fill the pipes is easily condensed if the pipes are cold and the fall of even a drop of water through a vacuous space of ten or fifteen feet, or the rush of water from opposite directions into a space in which steam has just been condensed produces loud noises that would not be made if there were enough air in the pipe to act as a buffer. But it does not seem likely that this explanation could apply to the action of steam in the internal crevices and caves of the interior of the earth, as is suggested by Mr. Eadie, because the surfaces of these cavities can hardly be cold enough to condense the aqueous vapor to the extent necessary to cause the observed phenomena. Neither would the sudden release of gas under pressure escaping into a subterranean passage act like a water hammer unless the passage were appreciably free from air, and this seems rather unlikely.

On the whole we are inclined to adhere to our general conclusions that these subterranean noises originate in the breaking, crunching, and sliding of layers of rock and earth under great pressure.

MIROBIA AND SEICHES.

Mr. F. Napier Denison has made a special study of the minute undulations recorded upon the self-registering tide gauges, and has compared them with the curves of the self-registering barographs for a number of points on the Atlantic coast of Canada and within the Gulf of St. Lawrence and the smaller bays. He finds that these minute undula-

tions in the water are due to the direct action of atmospheric waves or billows, or more properly speaking, oscillations of barometric pressure passing over the harbors and bays. To the Editor it seems that it would be much better to study the barometric oscillations directly as a meteorological problem, and, subsequently, to study their effect on the tides as an oceanic problem; but Mr. Denison finds reason to reverse the order of treatment. His results are of interest to those studying the oscillations of lakes and bays even if they are not so important to the meteorologist, and many readers of the MONTHLY WEATHER REVIEW will be interested in the following quotations from Mr. Denison's paper in the Proceedings of the Canadian Institute for November, 1898:

In 1838 this phenomenon was observed at Swansea, England, where a regular time interval of from fifteen to twenty minutes was noted. Some of these records were sent to Sir George Airy, who was then unable to account for them. Admiral Smythe referred to this phenomenon at Malta, where it had long been termed "mirobia," and supposed to be due to distant storms. In 1878, Sir George Airy read a paper before the Royal Society upon the tides of Malta, in which he speaks of these undulations as simple harmonic curves, whose heads are sometimes notched as by the intermixture of small waves. That they had a time interval of twenty-one minutes and a range of 12 inches amplitude, much exceeding that of the lunar tides. He believed that they were "seiches" similar to those discovered by Forel upon the Swiss lakes, and supposed them due to a reflexive action from the shores of Sicily and the African coast. Major Baird of the Indian Tidal Survey, referred to this phenomenon in 1868 as being most pronounced at the ends of bays, but offered no explanation. In 1896, Professor Duff, of Purdue University, studied these undulations at St. John, N. B., and Indiantown, and later presented a paper before the Royal Society of Canada, in which he also classed them as "seiches," due to some form of oscillation between the two sides of the Bay of Fundy. He does not attempt any explanation for the abnormal movements often observed during fine settled weather. Mr. H. C. Russell, of New South Wales, states that at Sydney what have been previously termed earthquake waves are in most cases due to atmospheric disturbances in some yet ill-defined manner, and have a marked 26-minute time interval from crest to crest.

Finally, these undulations are universal to a greater or less extent, as has been proved by a personal study of tidal records observed from all parts of the world.

CHIEF POINTS DEDUCED.

1. That the undulations are due to the direct action of atmospheric waves upon the surface of the water at stations, and not to ground swells due to distant storms or seiche movements, as found upon lakes during atmospheric disturbances.

2. There is a marked relative correspondence in amplitude between the barometric and water undulations.

3. That they often appear during fine settled weather, when the barometer is high over the station, but decidedly low to the southwest, frequently when over 1,000 miles distant.

4. That they increase in amplitude as the storm advances, the maximum usually occurring shortly before and at the time of the shift of wind, which also corresponds with the time of heaviest precipitation. This tends to prove that the axis of rotation of important storms is inclined toward the direction of its future course.

5. That after the storm has passed the station, these undulations rapidly diminish, although a heavy westerly gale may still be blowing, provided the temperature to the westward is fairly uniform. Should a cold or warm wave be approaching, marked undulations appear.

6. Should a southwest storm move with diminishing energy toward the station, the undulations correspondingly decrease as it approaches.

7. That the tidal records are most disturbed during winter and least in summer, due to the velocity of the primary poleward current being almost double in winter what it is during the summer months.

8. The disturbed traces during the summer months chiefly occur shortly before or at the time of showers or thunderstorms, and usually precede warm and cool waves.

9. Whereas, many of our storms are whirling eddies, developing from above downward, it is hoped a further study of these undulations may throw much light upon their future growth and course, even before the ordinary barometer begins to fall.

10. Meteorologists throughout the scientific world now realize that for the further advancement of weather forecasting, a better knowledge of the upper atmosphere must be obtained. Rapid strides are now being made in this direction by means of kites, balloons, and cloud observations. May we not add the study of atmospheric and water waves at the bottom of this aerial ocean, which can be carried on during all conditions of weather by means of sensitive self-recording instruments that have been fully described in a paper read before the Toronto meeting of the British Association in August, 1897.

BACK NUMBERS OF THE MONTHLY WEATHER REVIEW.

When requests for back numbers of the MONTHLY WEATHER REVIEW are received from those who desire to complete their sets and it appears that the stock on hand in Washington is exhausted, the Editor will mention such cases in the REVIEW, in order that those who are able and willing to supply the desired numbers may have an opportunity to do so. Penalty envelopes will be sent to those who desire to return their copies to the Editor.

No. 13 (Annual Summary, 1892), is desired by Prof. A. Angot, Paris.

The volumes, 1873–1888 are desired by the Secretary of the Canadian Institute at Toronto.

Prof. H. H. Hildebrandsson of Upsala, Sweden, desires the MONTHLY WEATHER REVIEW for the years 1887 to 1891, inclusive.

A NEW ELEMENTARY METEOROLOGY.

An elementary treatise on meteorology has just been published by Alfred Angot, meteorologist to the Central Meteorological Bureau in Paris and professor in meteorology at the National Agronomic Institute, and also at the High School of Navigation. This work is an outcome of Angot's lectures to the students at the two latter institutions rather than a complete treatise on meteorology. It is written for those who desire to become acquainted with the elements of meteorology and is not intended to expound all the facts known at the present time or to discuss critically the theories that have been proposed in order to explain them. Still, no question of any importance has been omitted. The laws of the general phenomena and their theories have been explained in detail but without having recourse to mathematical developments and without assuming that the reader has any but the most elementary knowledge of physics or mechanics.

The preface says:

In a work of this nature it would appear useless to multiply numerical examples, and tables of figures are replaced as far as possible by charts and diagrams. Similarly, we have suppressed the descriptions of instruments and technical details as to the methods of making observations; these questions interest only the observers and professional meteorologists and are to be found fully developed in all collections of meteorological instructions. On the other hand, the author thinks it well to give general indications as to the principles involved in the methods of observation, and the conditions that the observations ought to satisfy, in order to give results worthy of confidence.

Meteorology offers a most varied field of research both in the domain of pure theory and that of its applications; few sciences can be taken up more easily by isolated students and workers who have not at hand the resources of the large laboratories. However, France, which has heretofore played an important part in the development of meteorology, is to-day one of the countries where it is least cultivated; one can assure himself of this fact by looking over the statistics of books published every year in France and foreign countries. This difference is due to the fact that in France there is an entire absence of regular instruction in meteorology and in the physics of the globe. Except in the schools of higher agriculture, meteorology has no place in the curriculum of any of our establishments of higher education; on the contrary, in neighboring countries, including the United States, a large number of special chairs are devoted to it in all the higher schools and in the universities.

These words by Angot must awaken, in every one interested in the subject, a hope that the study of meteorology may be revived in France, and that its importance may become so highly appreciated as to lead to the establishment of courses of instruction in both the lower and higher schools. In America, such instruction is supposed to be an important feature in the ordinary public schools and high schools, so that every citizen may learn to make a wise use of the Daily Weather Map, and a more or less successful, local interpretation of the general forecasts that issue from the Weather Bureau. For this class of students, the beautiful volume by

Angot, which is published by Gauthier Villars, at the price of about $3.00, is eminently adapted, and we must commend it most heartily to all the readers of the MONTHLY WEATHER REVIEW who are familiar with the French language or have even made a beginning in its study, as Angot's style is very simple and clear. This work will come as a special boon to the meteorological observers and students of Lower Canada and the French colonies of the East and West Indies, and possibly to many of the citizens of the Louisiana Purchase.

Among the illustrations we notice the beautiful photographs of clouds for which Angot has long been famous. His explanation of the formation of clouds and rain is, of course, in harmony with the latest views of physical science. In fact, in every respect this volume represents the present condition of our knowledge about as correctly as would seem practicable in an elementary work.

THE ROYAL METEOROLOGICAL SOCIETY.

This Society which has done so much for meteorology has for many years been located at 22 Great George street, Westminister, London, S. W., but now announces its removal to Princes Mansions, 70 Victoria street, Westminister, London, S. W. American meteorologists, both students, teachers, and observers would do well to correspond with this Society through the Assistant Secretary Mr. William Marriott, in so far as they desire to keep in touch with the progress of meteorology in Great Britain and her colonies. The Society publishes an excellent monthly journal and extends its interest over all parts of the world. Of course, it does not receive much relative to America, but that may easily be remedied by communications from our own citizens. Its publications are sent to those who become members of it, and it is fair to presume that in the absence of a special American journal that of the Royal Meteorological Society of London may serve as a medium for the English-speaking world.

CIVIL SERVICE EXAMINATIONS FOR ASSISTANTS.

The remarks on a preceding page by Mr. Kimball are quite in line with the experience of the Editor with reference to the examination papers submitted by some of those who recently took the examinations in "Division A" for the grade of "assistant in the Department of Agriculture." This grade has reference to the scientific and technical positions in the Department, and the applicant is submitted to an examination in one special subject as a major, and two or more correlated subjects as minors, according to section 67 of the recent editions of the Manual of Examinations. The successful applicants are appointed to the lowest class as regards salary, and are then in line of promotion to higher positions; the initial salaries vary between $840 and $1,600, and promotions to salaries of $2,500 and $3,000 may follow. As the duties required imply much technical knowledge, and often considerable responsibility, it is necessary that the competitive examination should be correspondingly thorough.

The actual examinations in physics and meteorology have frequently shown that the applicants had such an imperfect knowledge of these subjects as to suggest that they had had no opportunity of properly preparing themselves for the work. They were not the class of men that were needed to fill such positions. A second examination of the same kind will undoubtedly be held in April, 1899, and it is to be hoped that a better class of men will apply. Those who have merely done well in the best high schools of the country stand little chance of passing these examinations, which are intended especially to secure young men who have pursued special studies in the higher scientific schools.

Hereafter these major examinations in meteorology should presuppose a knowledge of Loomis's Three Contributions to Meteorology, Ferrel's Recent Advances in Meteorology, Cottier's Equations of the Movements of the Earth's Atmosphere, Abbe's Mechanics of the Earth's Atmosphere, and his Treatise on Meteorological Apparatus and Methods.

In the examinations for assistants more than one day is required. Three hours are given to the major subject, and two hours for each minor. The whole examination is divided into five parts, and the credits are given on the following scale:

	Per cent.
Orthography	1.5
Arithmetic	2.5
Letter writing	2.5
Penmanship	1.5
Copying	2.0
General training and experience	5.0
English composition	5.0
Major examination in special scientific subject	50.0
Minor examinations in two required subjects	20.0
Minor examinations in electives	10.0
Total	100.0

An applicant for the position of assistant in the Division of Soils would, for instance, have to take his major examination in physics, especially as applied to meteorology and soil study. His minor examinations might be in meteorology, physical geography, Latin, German, French, Italian, Swedish, or Spanish.

An applicant for the position of assistant in the Weather Bureau would take his major in meteorology, his minor in physics, physical geography, and modern languages.

The term assistant is used here in a general way to designate officials whose duties are scientific rather than clerical, and whose rank and pay are next to those of the chief and assistant chief of the respective divisions of the Department of Agriculture.

As the chief purpose of the examinations is to provide eligible registers for appointments to technical and scientific positions of the lower grades, the standards for the examination questions and papers should be made with reference to the necessary qualifications for such positions, and should be of a uniform grade in the different subjects.

As regards the higher scientific and expert positions, in case vacancies are not filled by promotions, special examinations will be ordered by the Commission whenever it appears that existing registers do not contain eligibles having the qualifications necessary for the positions to be filled.

The above examination for the grade of assistant is much more difficult than that prescribed for the position of observer, as defined in section 91 of the Civil Service manual. The latter covers the following points:

	Per cent.
Spelling	5.0
Arithmetic	5.0
Letter writing	5.0
Penmanship	5.0
Copying from plain copy	5.0
Copying from plain draught	5.0
Meteorology	40.0
Essay writing	20.0
Geography	10.0
Total	100.0

The samples of questions published by the Civil Service Commission show that this examination for observers is, as regards meteorology, about equivalent to the easier portions of the published elementary meteorologies of Waldo, Davis, and other popular authors, but it is not probable that one who crams either of these books into his memory and neglects the broader education obtainable in our best high schools will make a very good showing at the examination.

If there should be no vacancy in the grade of assistants, properly so called, there is still likely to be an opening in the

grade of observers in the Weather Bureau. Those who pass the examination for assistants will, of course, be also eligible as observers, and their promotion to higher grades will follow in due course.

The steady progress of meteorology and the increasing scope of the work of the Weather Bureau justify a demand for the services of the best class of men. Inasmuch as the highest professorships must be filled by steady promotion from the lower ranks, and as they presuppose a wide range of knowledge in physics and mathematics, languages and meteorology, it is evident that the young men who enter the service of the Weather Bureau must show acquirements that give promise of future study and progress and, consequently, eminence.

It is not to be denied that many who would naturally have made meteorology their life work, failed to do so because in early life no stimulus by way of instruction in this line of study was available. At the present time, however, this need can easily be supplied, since many high schools are introducing physics and meteorology into their courses of instruction, and the colleges will, undoubtedly, introduce it into their curricula as soon as the funds are provided to satisfy the increasing demand.

It is, however, a grave question whether in the present condition of affairs it would not be well to have at Washington a central school for both elementary and advanced courses of instruction in physics, mathematics, climatology, meteorology, and modern languages. This would relieve observers in charge of stations of the necessity of training inexperienced men in their duties, and secure both greater uniformity and higher standards in the attainments of the Weather Bureau observers. If a four-years' course is necessary for the preliminary education of a second lieutenant in the Army and the ensigns in the Navy, still more must this be true of the men who are to do the weather forecasting, river and flood predictions, and cognate scientific problems of the highest complexity that are pressing upon us for solution. The general organization of the Weather Bureau, like that of all Government offices, looks to the accomplishment of a great amount of very useful daily work, but, in addition to this, there is a demand for the solution of difficult problems in science as a prelude to still wider and more important daily work. Such solutions are not likely to be forthcoming until we have evolved men who have the genius and the training necessary for original research. Our standard of scientific efficiency must be raised higher.

RHODE ISLAND WEATHER.

Mr. William Foster, Jr., of Warwick, R. I., writes:

In my younger days I was a pretty close watcher of weather phenomena. * * * On several occasions I suggested in the public papers that the Government should institute definite observations throughout the country for obtaining the necessary data to determine the laws of storms. Though this has now been done the end is not yet. There are influences coming in which seem to block the general trend of the ordinary conditions. Hence, forecasts sometimes fail and the Weather Bureau gets a scoring. Early this season I removed from Providence to Warwick * * * and have become satisfied that some of our conditions here are abnormal. In July, August, and September, I noticed that the smoke from the locomotives passing in front of the station presented a peculiar appearance not readily mingling with the atmosphere. I also noticed that there is a prevalent haze, but this has passed away since early in November. Has this been observed elsewhere?

ST. ELMO'S FIRE.

Mr. E. P. Alexander, from Georgetown, S. C., communicates the following interesting item:

In August, 1885, I was traveling from Shoshone Falls, Idaho, to the Union Pacific Railroad about dark of a cloudy afternoon. The country is uneven tableland of volcanic formation, moderately covered with sage brush and a raw wind of about 8 miles per hour faced us. As darkness approached, from a rear seat I saw a faint streak of light on the frayed end of a stout switch with which our driver drove his tired mules. I vaguely thought that the sun must be still above the horizon and shining horizontally through a very fine slit in the clouds, so as to catch the end of the switch 3 feet above the level of my eye, but not observable by me. But in about three minutes the driver struck the mule again, and again there was a streak of light illuminating the top of his switch as it was raised in the air. I borrowed his switch and raised it over my head and about 3 feet above, the end of it glowed with something like St. Elmo's fire. It was sharply extinguished when held just below that level, and as sharply ignited when raised into or above it. The phenomenon was repeated as often as we tested for it until we reached our destination, the nearest station to Shoshone Falls. My idea at the time was that the friction of the breeze on the resinous foliage of the sage brush had in some way caused the existence of an electrified current about 8 feet above the earth, such as that which causes the St. Elmo's lights at sea.

BALL LIGHTNING.

The following letter from Mr. Edward M. Boggs, civil and hydraulic engineer, at Los Angeles, Cal., seems to corroborate the suggestion of the Editor on page 358 of the August REVIEW. If our explanation is correct, then similar phenomena should be frequently observable by the employees on our railroad trains. Will not some one inquire of them?

Referring to the supposed "ball" lightning described by Mr. C. N. Crotsenburg on page 358 of the August REVIEW, I beg to offer the following as a plausible explanation of the phenomenon:

The appearance and the movements of the luminous body were such as might be caused by the reflection of some strong light, carried on the train, from a close succession of raindrops depending from a telegraph wire. Perhaps the strong red glare from the locomotive fire box was the origin of the light. The undulations of the telegraph line would change the height of the object, cause its observed oscillating motion, and would account for the seeming change in horizontal distance and the occasional disappearances, while the varying angle of reflection, due to curves in the road, would cause the light to gain or lose in distance alongside the train.

Mr. T. P. Yates, voluntary observer at Waverly, N. Y., writes, under date of November 12, as follows:

I was much interested in your "ball lightning" article in the August REVIEW, but disappointed at there being no more data. I now give you a narrative related to me by Morris Barton some years ago, who saw it at the time he lived near Danby [Danbury?], in Connecticut:

"I was standing in a barn boor, facing a farmhouse, during a passing thunder shower, in the daytime, when my attention was taken by a ball of lightning moving toward the house. It entered the room through an open door, and passed out of an opening on the other side into the open air and out of my sight, and directly after there was a loud explosion as the ball encountered an apple tree beyond, which shattered the ball to pieces."

Further questioning only elicited the facts that "a woman who was doing some housework in the room was greatly frightened;" that he "drew a breath of relief when it passed out on the other side;" that "it was as big as a pumpkin and of a deeper color;" and that "it floated and bobbed leisurely along until it hit the tree." I have no doubt he gave a correct account as it appeared to him. This is the most authentic account by an eye witness that I have come across. Nothing of the kind has yet come before my vision.

The exact date of the above occurrence can not now be stated, but it was over twenty-five years ago. Possibly some one now living in Danbury, Conn., may be able to send it to the Editor.

CLOUD PHENOMENA AT SUNRISE AND SUNSET.

Mr. S. L. Brooks, voluntary observer, The Dalles, Oreg., forwards two beautiful photographs showing streaks of light illuminating the under surface of a layer of alto-stratus cloud just before sunrise of December 2. The illuminated cloud resembles the tail of a comet reaching from the horizon far up to the northeast over an arc of nearly 90°. After 8:15

a. m. the sun shone through this cloud, dissipating it temporarily. On December 3, a similar light was observed at about the same hour, but the cloud was denser and was not subsequently dissipated.

Mr. Brooks's photograph is the first that we have seen illustrating the delicate illumination of the under surface of a cloud at sunrise or sunset. But such phenomena are very common and always excite admiration during sunsets in the eastern portion of the United States. They are especially brilliant when the sky is clear in the distant west so that as the sun disappears below the horizon in a dry, clear air his beams, for a few minutes strike upward on the under surface of a broad layer of clouds. Under these conditions, the observer sometimes sees long streaks of gorgeous colors, at other times symmetrical arrangements of bright spots, both of which show that the under surface of the cloud is not a smooth and uniform surface, but is sometimes thrown into waves, the lowest limits of which are illumined by the sun; at other times it is thrown into irregular dimples and is full of masses of denser cloud distributed among the lighter and rarer material.

From an artistic point of view photographs of these sunset illuminations have much interest, but from a meteorological point of view still more. One of the oldest methods of determining the height of the clouds consists in measuring the angular altitude and azimuth of a cloudy point that is just on the border between the dark section of the sky and the illumined portion. By noting the time exactly, one is able to compute the apparent position of the upper limb of the sun, and by assuming that the light from the upper limb is that which, grazing past the edge of the spherical earth, last falls upon the cloud, one can easily calculate the point at which this line intersects the line of sight of the observer and, therefore, the point at which the clouds must exist. Special tables to assist in this calculation were published by Zenker in his Meteorological Calendar for 1887. The method in general was proposed by James Bernoulli in 1744, and was extensively applied by Liais in 1854, but in its application one must be very sure that the beam of light from the sun grazes the surface of the ocean or the lower level planes of the earth's surface and not the tops of clouds or mountains.

If such beautiful photographs as those of Mr. Brooks could be accompanied by two necessary items, namely, the exact second of the correct time and a scale of angular altitude and azimuth, then Bernoulli's method could be applied to a large surface of alto-stratus cloud and would give us much information with regard to its altitude and its irregularities.

DISTANT THUNDER.

The Rev. J. J. Abell, of the Bethlehem Academy, St. John, Ky., makes the following interesting observation:

On the evening of January 12, 1899, at 7:07, central time, the writer observed lightning to the northwest. He began counting seconds, but ceased counting after a minute and a half had elapsed without audible thunder. Low and heavy thunder began rolling in the northwest upward of a minute later. This was so remarkable that with watch in hand he awaited a repetition of the lightning.

At 7h. 11m. 05s. he observed a flash that illumined a band along the northwest horizon about 50° long and 10° wide. At 7h. 13m. 45s. came the heavy, low, but unmistakable roll of thunder, again from the northwest.

The air was perfectly calm, and its temperature 49° F. The geographical position of the observer was latitude, 37° 42′ north; longitude, 86° 00′ west (Greenwich).

Mr. Abell remarks that the above interval of 160 seconds, with an air temperature of 49°, corresponds to a distance of 33.6 miles. This observation is interesting in connection with the statement made in many text-books that an interval of longer than eighty seconds is rarely or never observed.

A NEW STYLE OF ANEROID.

According to a circular received from Mr. Edward Whymper, a modified form of aneroid has been invented by Col. H. Watkins, of the British Army, which has given better results in the hands of surveyors and mountaineers than any other thus far tried by Mr. Whymper. The instruments of this kind are now made by Mr. J. J. Hicks and will be known as Watkins' Mountain Aneroids.

Mr. Whymper states that all aneroids, when carried to higher points in the atmosphere, lose with respect to the mercurial barometer, that is to say, read lower than it. When tested under the receiver of an air pump, when the pressure is diminished rapidly, the aneroid will, in a short time, read lower than the mercurial even though they may agree exactly at the first minute. The greater the length of time that the aneroid is kept under low pressure so much the greater is the loss. It appears, moreover, that when returning to the normal pressure at sea level the aneroid will, in the course of time, recover all its previous loss and read correctly.

Manufacturers and inventors have endeavored to diminish these errors. The former have attempted to abolish the fundamental cause, and the latter to shorten the length of time that the corrugated disks are exposed to the influence of the low pressure.

The Watkins aneroid is so constructed that the corrugated disk is put in action when required and thrown out of action when it is not wanted for use. In order to accomplish this the lower portion of the vacuum box, instead of being a fixture, is free to rise, thus relieving it of any strain. When a reading is required, a fly-nut is screwed up as far as it will go, thus bringing the instrument into the normal condition in which it was graduated.

Actual comparison between aneroids and mercurials throughout Switzerland in 1898 seems to show that the new form of aneroids is about as good as the mercurial barometer itself. It is very unfortunate that the new instrument does not easily lend itself to continuous registration as in the case of the ordinary aneroid.

LOW PRESSURES AND TIDAL WAVES.

Mr. H. C. Russell of Sidney, New South Wales, is said to have proved that of the so-called tidal waves observed near that place only 1 per cent is produced by seismic disturbances, while 60 per cent is due to low pressures producing waves in the South Pacific.

A tidal wave, as we have said in the MONTHLY WEATHER REVIEW for 1896, must not be confounded with a wind wave or waves produced by earthquakes. The use of the term tidal is oftentimes quite improper and unwarranted. The great waves that are reported on the Australian tide gauges may be due to heavy winds, but there is no reason to think they are due to special tidal action.

FLOATING SPIDER WEBS.

A paragraph in the Advertiser of Montgomery, Ala., states that on November 21, numerous batches of a spider-web substance were seen floating in the air and falling from the trees and leaves to the ground. Some of it was in films 15 or 20 feet long, but occasionally masses a few inches in length and an inch or more broad were observed. The author of the paragraph states that it was not spider web but resembled fine fibers of asbestos, and that it was probably connected with the fall of November meteors. It is also said to have shown a phosphorescent effect.

As there are several species of spiders that float indefi-

nitely through the air by means of their delicate webs, the Editor sees no reason to think that the above-mentioned phenomenon was of any other nature. It does not seem possible that the burning up of meteors could in any way have produced these delicate webs.

THE BAROGRAPH ON SHIPS.

Mr. H. W. Richardson, local forecast official, Weather Bureau, at Duluth, Minn., published in the Evening Herald of January 3, 1899, an interesting account of the efforts made by the Weather Bureau to increase the safety of navigators by introducing the barograph into daily use. He says the first barograph used on the Lakes was placed by the Weather Bureau in 1892 on the steamer *J. D. Moran*. The record sheet gives practically the record of the ship's course, with the air pressure, the wind, and the state of the weather during her whole trip. The prime object of placing the barographs in the hands of navigators was to educate them in the practical use of the barometer in connection with the daily weather map.

During the present season, navigators on the Great Lakes who have used these instruments say that they have received great benefit from watching the action of the barometer.

Of the forty navigators who used the barograph during the present season, only three have said that its use was not of sufficient importance to them to be further desired.

WEIGHTS AND MEASURES IN PORTO RICO.

As there seems to be some little discrepancy between the weights and measures legalized by Spanish law and those actually in use in Porto Rico and other Spanish colonies, the Editor has collected the following recent information on this subject from the following authorities.

(1.) In a letter from Señor Antonio Mattei Lluveras, author of a recent work on Porto Rico, the following statement is made:

* * * In my letter of the 2d, from which I quote, I told you that a "cuerda," an agricultural measure of Porto Rico, represents a surface of 75 varas in length and 75 varas in breadth, or 5,625 square varas of level surface, which is equal to 39 ares, 30 centiares, and 39 miliares.

In reply to your question, "Which is the vara which is used in Porto Rico?" I would say that it is the vara of Burgos which is used, and it is equivalent to 835.905 millimeters, or 32.875 English inches.

But the Spanish Government, by the Spanish law of July 17, 1849, adopted the metric decimal system, and a few years later ordered that it be adopted in Porto Rico, and finally forbad the word "cuerda" to be used in any public document for the purchase or sale of land and established the equivalents, "Ordered, That the reduction of the cuerda to the new system be calculated at 39 ares, 30 centiares and 39 miliares." Consequently, it may be said that the cuerda is not officially used in Porto Rico, although all the Porto Ricans, in conversation and verbal contracts for the sale, purchase, or rental of land, always use the "cuerda." When, however, they go before the notary public to draw up the official written contract it is always calculated in the manner before mentioned, that is to say, each cuerda is reduced to 39 ares, 30 centiares, and 39 milliares.

From this we gather that the legal cuerda in Porto Rico is 39.339 ares, or 0.39339 hectares. The hectare is 2.471 acres, according to the Act of Congress of July 28, 1866; hence, the cuerda is 0.97212 acre.

(2.) According to a letter of February 7, from Prof. M. W. Harrington, section director at San Juan, a special investigation has, at his request, been made by Señor Don Pedro J. Fernandez with the following results:

The fundamental units are the foot or pié which measures 0.27863 metres or 10.9697 inches; the *vara-cuadrada*, 0.69872881 square metres, or 0.8356 square yards; the pound or *libra* of 460 grams, or 1.0141 avoirdupois pounds; the *galon* of 3.785166 litres, or closely the American wine gallon. The cuerda, which is the Porto Rican land measure and varies, as do all Spanish measures and weights, with the notions of the seller, is popularly put at two-fifths of a *hectairia* or hectare, that is, 0.9884 of an acre. Señor Fernandez makes it 3930.35 square metres, or 0.9704 of an acre.

(3.) A letter from Prof. H. S. Pritchett, Superintendent of the Coast and Geodetic Survey, says:

As to the value of the vara used in Porto Rico. I have to say that the metric system was made obligatory in 1888, and according to the Tables of legal equivalencies, published soon after, 1 vara equals 0.835 metre. The more precise equivalent, however, is given as 1 vara equals 0.835905 metre, and 1 metre equals 1.196308 varas. This would give 1 vara equals 32.910 inches, a value differing from both the values mentioned by you, but approximating that of Burgos much more nearly than the other.

From these figures, we find the obligatory vara to be 2.7425 feet. The corresponding cuerda is 0.971243 acre.

THE WATERSPOUT OF SEPTEMBER 29.

In the September REVIEW, page 402, Mr. Henry notes a waterspout on the Mississippi coast, September 29, at 6:50 p. m.; but a recent letter from Mr. W. T. Blythe, section director, at Vicksburg, Miss., states that it was 6:50 a. m. Mr. Blythe forwards the following full description of the spout as observed by a voluntary observer, Brother Isidore, of Bay St. Louis, Miss.:

The waterspout of September 29 occurred at 6:50 a. m. I noticed the waterspout forming about three-quarters of a mile off the coast, directly in front of the college wharf, and moving rapidly west by northwest for about five minutes. When within three hundred yards of shore it veered to a northerly direction for about three hundred yards, then rose into the air, and again veered to a westerly direction, and went inland in the form of a whirlwind. Its path could be easily followed for a mile or so by the leaves and small branches it carried up with it. While off the coast it was of no violence, having passed over several bath houses without doing any damage, but, from report and observation, as soon as it struck the mainland it increased in violence, breaking off large branches from trees and overturning three small houses in the western part of the town. No news or reports were received from the interior, so damage must have been light, or the spout may have ascended into the air.

A CRUDE HYGROMETER.

A voluntary observer, Rev. W. H. Kaufman, of Oakville, Chehalis County, Wash., sends an account of his efforts to determine the moisture in the air by means of a crude form of dew-point apparatus which may be described as follows:

A 2-quart glass fruit jar with a screw top of zinc, known as Mason's patent, is provided with a pipe supplying cold water and a waste pipe so that a continuous circulation of cold water through the jar can be maintained. A stopcock in the first pipe regulates the supply. A thermometer is also hung within the jar. In order to find the dew-point, open the stopcock and admit a flow of cold water rather slowly, so that in five or ten minutes dew will begin to gather on the outside of the glass jar. At this moment read the thermometer inside of the jar. Cold water may be admitted from the city water pipes, or failing these, from a pail of water set above the jar and connected with it by a rubber tube syphon.

The Editor would remark that this arrangement must be considered as wanting in sensitiveness and delicacy, but will certainly give results correct within three to five degrees, in case of very moist atmospheres such as occur on the coast of Washington and Oregon. But in such cases the wet bulb thermometer is more convenient. One has but to provide two thermometers, one of which is to have a bit of the thinnest muslin neatly tied around its bulb and kept soaked with water. Lift this out of the water and whirl it briskly through the air for two minutes if the air is very dry, but for three or four minutes if the air is quite moist, read it quickly and we have the so-called wet bulb temperature, which is lower than the dry bulb temperature. It gives the temperature of a thin layer of water evaporating under the influence of the

wind produced by the whirling. The dew-point of the air in which the thermometer is whirled is about as far below the temperature of the wet bulb as this is below the temperature of the dry bulb, if the latter has been similarly whirled and read rapidly. These two thermometers may be hung side by side on a short piece of string for convenience in whirling and are then called the sling psychrometer. On account of its convenience and portability, the sling psychrometer replaces the most delicate dew-point apparatus in all ordinary meteorological work. Mr. Kaufman submits the following problem:

Given the temperature of the air and of the dew-point with the height of the barometer, what does this mean in the light of our latest science? We have great trouble here in making good hay, so that this is a very practical matter.

We understand our correspondent's question to be a purely practical one. What bearing has the temperature, moisture, and pressure of the air upon practical farming operations, especially hay making? Can not some observer at a State agricultural college or experiment station answer this question?

THE WEATHER BUREAU AND THE UNIVERSITIES AND COLLEGES.

Again we have to chronicle the encouragement given by the colleges to the intellectual and educational side of the work of the Weather Bureau. Mr. D. J. Herndon, observer at Lexington, K. Y., informs the Chief of the Weather Bureau that the authorities of the Kentucky State College will furnish free office quarters and space for instrumental exposures. A well-lighted room has been placed at the disposal of the Weather Bureau. * * * The college authorities will have all necessary changes and improvements made at their own expense.

Similar arrangements are now in force at the following institutions:

Baltimore, Md.—Johns Hopkins University.
Columbia, Mo.—State University, Agricultural College.
Ithaca, N. Y.—Cornell University, engineering building.
Knoxville, Tenn.—University of Tennessee.
Lincoln, Nebr.—University of Nebraska.
New Brunswick, N. J.—State Experiment station.
Northfield, Vt.—Norwich University.

In all these cases the Weather Bureau offers a full equivalent by way of lectures and teaching, weekly crop reports, monthly meteorological returns and daily forecasts. The union of the two brings about an increased attention on the part of the students to the study of meteorology and climatology, and makes them by so much the more intelligent and better citizens. Similar intimate union between the State universities and the many scientific divisions and bureaus of the Federal Government can but lead to important advantages on both sides.

CHINOOK AT HAVRE, MONT.

Mr. C. W. Ling, observer at Havre, Mont., sends a tracing of the thermograph record for December 18–20, from which it appears that the temperature fell steadily from 45° F., on the afternoon of December 18 to about 18° F., at about 6 a. m. December 19 (seventy-fifth meridian time). After rising slowly for over half an hour, in accordance with the regular diurnal variation the temperature took a sudden jump a little before 8 a. m., and within ten minutes rose from 24° to 44°. After a half hour of this high temperature, there was an equally sudden fall to 30°, and after an hour of this temperature, a precipitous rise back to 44°, where it remained until late in the afternoon. Mr. Ling says that—

We have here two pronounced chinooks within four hours of time; the first chinook was evidently shut off for a few hours by a cold stream of air.

The Editor has often remarked upon the great variations of temperature that sometimes take place within a short period of time, during the prevalence of a chinook. It seems evident that the rapidly descending air, which is thereby warmed, is also mixed with masses of air near the ground that have not descended. Alternations of temperature of 3°, 5°, and 10°, within five minutes have been observed by himself, by Buchanan, and, doubtless others, but we know of no case where the alternation was so great as in the present instance.

NORTHERS IN THE CARIBBEAN SEA AND THE GULF OF MEXICO.

Although our West Indian service was immediately organized in view of the approaching hurricane season of 1898, yet the officials of the Weather Bureau were not unmindful of the fact that the northers in the winter season were of equal importance to the commercial shipping interests of that region. On many occasions, ever since the first predictions of November, 1871, the Editor has explained the movement of the so-called northers of Texas, and an interesting illustration of the progress of a norther over the Gulf of Mexico will be found in the MONTHLY WEATHER REVIEW for December, 1893, pages 363–364, and the accompanying Chart, No. I. Frequently the combination of a high area in the Mississippi and a low area on the Atlantic coast draws the cold air farther eastward so that it overflows a large part of Cuba. The northers of Havana have been especially studied by the officials of the Belen Observatory. We have not yet much data with regard to the progress of northers, southward over the Caribbean Sea, but the fact that severe northers occur at Colon shows that they must either proceed from high areas over the United States or else from low areas south of the Isthmus of Panama. It is to be hoped that our West Indian system will enable us to investigate this subject and predict the northers for the Isthmus of Panama as accurately as we can those for Vera Cruz, Tampico, and Havana.

RECENT EARTHQUAKES.

Sunday, August 7, at Oakland, Cal., and on Sunday, August 28, and Wednesday, August 31, at San Leandro, Cal.; both of these shocks were quite slight.

A very circumstantial account of an earthquake on Saturday morning, September 17, at Morrills Corner (described on page 415 of the September REVIEW) and North Deering, both located near Portland, Me., has been followed up by correspondence which has convinced the Editor that the whole story is a so-called fake. We can understand that political, religious, or local jealousies may suggest the publication of fakes, hoaxes, fictions, or lies, but it passes our comprehension why a respectable journal should print such matter relative to any form of natural phenomena.

Friday, October 23, at Cleveland, Ohio, three successive shocks are reported by the newspapers to have been felt during the night. Prof. E. W. Morley, of Adelbert College, Cleveland, reports several disturbances shown by the seismograph during October, caused by blasting at a point about 800 feet southwest of the instrument. Only the most powerful blasts made any record. The most vigorous movement occurred on October 29, and was probably due to some seismic disturbance. Professor Morley further reports that the seis-

mograph was not disturbed during November and December.

Friday, November 25, at the following stations in Virginia: Bedford City, Bonair, Buckingham, Colmans Falls, Fredericksburg, Blacksburg, Burkes Garden, Grahams Forge, Lexington. On this date, November 25, shocks were also felt at the following places: Pulaski, Va., a slight shock, lasting half a minute, at 3:10 p. m.; Radford, Va., a distinct shock, lasting ten or twelve seconds, at 3:05; Wytheville, Va., alarming, twenty seconds duration, at 3:10; Roanoke, Va., plainly felt; Lynchburg, Va., duration fifteen or twenty seconds, at a few minutes past three; Danville, Va., duration five seconds, at 3:07; Norfolk, Va., two very slight shocks at a few minutes after three; Winston, N. C., distinct, at 3:10 p. m.; Franklinsville, N. C., very distinct, at 3:05 p. m.; Charlotte, N. C. distinct, at 3:10 p. m.; Oakvale, W. Va., very severe, lasting about twenty seconds, at 3:08 p. m.

Professor Marvin reports that the seismograph belonging to the Weather Bureau was moved from one room to an adjoining one during November, and was reinstalled apparently just at the right time to give a very satisfactory record of the earthquake of Friday, November 25. The instrument shows that the tremor reached Washington, D. C., at exactly 3 h., 10 m., 30 s., p. m., seventy-fifth meridian time. In addition to Professor Marvin's seismograph, the only other observation in Washington was made by Mrs. N. G. Sprague, No. 705 Mount Vernon Square, N. W., who reports, "A lounge rocked slightly at 3:10 p. m. for less than half a minute."

Mr. R. D. Buford, of the clerk's office, Bedford City, Va., reports through the Chief of the United States Geological Survey, an account of earth tremors on the farm of Mr. Henry Creasy, near Otter Hill, Bedford Co., which have continued almost constantly for more than a year. The tremors in the valley of New River were the subject of a special investigation by Mr. N. R. Campbell, of the Geological Survey, in 1897. His report will give all necessary information to those interested in the subject. These tremors apparently arise from the sliding of the stratified layers of rocks over each other; they are in a state of great strain, and are continually cracking and sliding; the individual motions are extremely small in the case of slight tremors, and only amount to a few feet in the case of the heaviest earthquake.

THE MOON AND THE WEATHER.

The Editor has been requested to remark upon some special ideas with regard to the relation of the moon to the weather.

A gentleman at Huntington, Ind., states, as a general observation, that—

> The position of the moon at new moon forecasts the temperature for the following lunar month. Thus, on June 18, 1898, the new moon occurred 25° farther north than on July 18, and much farther than on August 17. Has this northing any special relation to the weather?

The Editor must answer, "No." Every careful study of suspected relations between the moon and the weather has shown that there are none. The same lunar phenomenon that is said to produce cold or rain in one part of the world is said to produce just the opposite somewhere else. The moon is too cold to radiate much heat, so that all phenomena that involve heat must depend upon the sun. True, the moon has an attractive power and can cause tides in the ocean as important as those caused by the sun, but that has little to do with our atmosphere. The atmospheric tides have not yet been shown to be important.

UNEQUAL DISTRIBUTION OF SNOW.

Having noticed the marked discrepancy between the depth of snow at Plattsburg, N. Y., and adjacent stations, further information was solicited from section director, Mr. R. G. Allen, who states that—

> There has been no snow this season (up to December 19) at Plattsburg or along the Champlain Valley, except flurries, while west of Lake Champlain, say 15 miles, snow is from 12 to 20 inches in depth.

RECENT METEORS.

November.—The occurrence of the November shower of meteors seems to have tempted active newspaper correspondents to add their own unnecessary exaggerations to the great stories reported by the ship captains. Thus, Captain Gartel, of the bark *Quevilly*, which arrived at Philadelphia November 25, and sailed away a few days later, stated that on November 15 a huge meteor flashed out of the heavens and fell with a tremendous splash directly in the path of the vessel. The numerous other details published in the Philadelphia papers are generally considered to be the invention of the newspaper reporter. We should probably discredit the whole story had we not a similar report from Capt. H. C. McCallum, master of the barge *Masaba*, of the Minnesota Steamship Company. Over his own signature he writes from Two Harbors, Minn., to the Weather Bureau, as follows:

> I, with my second mate, wheelsman, and lookout, saw a meteor fall from the heavens Monday, about 11 o'clock p. m., November 14.
>
> We were about 20 miles east of Standard Rock, steering west, and this meteor was due west, or dead ahead when it fell. It was blowing a gale from the west-southwest at the time. It gave me quite a start and also a scare at the time; never saw anything like it before, and for my part never want to see one again. It was about the size of an oil barrel and lit up the heavens, it being white with colors on the edges.
>
> Captain Morgan of the *Marina* saw it; he was abreast of Copper Harbor, Mich., and it fell in the direction of Houghton, Mich., at about 11 o'clock, so it must have fallen somewhere in that vicinity, as we were 50 or 60 miles due east of Houghton and on a line with the fall of the meteor.

As there is nothing at all impossible in the fall of a meteor into the ocean or the Great Lakes, we may probably give credence to the two reports above quoted.

A report from Perry, Okla., to the effect that several meteors fell near that place about 11 o'clock p. m., November 13, proves to be entirely false. It is denounced with indignation by Oklahoma papers, and is reported to be untrue by our own section director. As the report was widely copied the Editor is obliged to warn students of meteorites against accepting it.

December 2.—On the morning of December 2, after daylight, a meteor one-fourth as large as the full moon, with a long scintillating train, the head being as bright as an arc light, was seen by many persons at Cumberland, Md. Mr. Howard Shriver states that it moved in a northerly direction and disappeared beyond the right-hand peak of the Narrows.

An equally remarkable meteor seems to have been seen elsewhere. A report comes from Randall, Kans. (39° 45′ N., 98° 2′ W.), to the effect that a huge meteorite fell on the evening of December 2, but further inquiry has failed to confirm this story.

The exact height and path of a bright meteor like this can only be determined when various observers note the apparent angular azimuth and altitude of at least two points in the path as seen by each. The two best points to observe are the end or disappearance of the meteor and the position when nearest the observer's zenith.

OPTICAL PHENOMENA.

Mr. Howard Shriver, of Cumberland, Md., describes a beautiful optical effect. He states that when the twigs of a tree are fine and close, the light from an electric arc lamp shining

between them appears to an observer to form complete rings or concentric bands of brightly colored lights. To some observers the smallest circle at the center appears to be nearer the eye and the larger circle nearer the light; to other observers the opposite appears to be the case.

Several attempts at an explanation have been made in the Cumberland newspapers, but we think the truth is that the circles of light are produced by the optical action called interference of the waves of light. A beam of light, as analyzed by a prism, is said to be composed of an almost infinite number of waves which are exceedingly short and oscillate with great rapidity. The slower oscillations produce red and yellow lights while the most rapid oscillations produce blue and violet lights. If we pick out a single set of homogeneous waves producing yellow light, for instance, we find that as these attempt to pass by the edges of the twigs, or any other object, they curve around the edge and are said to be inflected or diffracted very much as waves of water or of sound curve around any obstacle. The wave that curves around one edge of a twig will interfere with the one that curves around the other edge, and as they both pass on they intersect and interfere with each other so that there are places in the path of each wave where one neutralizes the other, producing darkness. Midway between these bright regions are others where they reinforce each other producing greater brightness. These dark and bright places are arranged in circles around the central line of sight from the eye to the arc light. The circles made by the blue rays are a little smaller than those made by yellow or red light, therefore, with ordinary light the eye usually perceives concentric bluish and reddish rings if these are not overpowered by the yellow ones.

This phenomenon was first studied by Sir Isaac Newton (who thought that light was the effect of minute atoms shot in straight lines from the sun to the earth), and he explained it, as well as the colors of the soap bubble, by assuming that the atoms had "fits of easy reflection." But modern students have been better satisfied with the wave theory of light and the interference of waves as described above.

We shall not attempt to explain why some observers imagine the smallest, central circles farther off than the larger outward ones, while others imagine the contrary. This is a so-called subjective phenomenon and its study belongs to psychology. In an instrument for determining the average diameter of the fibres of wool, hair, cotton, etc., this same principle was made use of early in this century, before the microscope was brought to its present degree of perfection.

METEOROLOGICAL TABLES AND CHARTS.

By A. J. HENRY, Chief of Division of Records and Meteorological Data.

Table I gives, for about 130 Weather Bureau stations making two observations daily and for about 20 others making only one observation, the data ordinarily needed for climatological studies, viz, the monthly mean pressure, the monthly means and extremes of temperature, the average conditions as to moisture, cloudiness, movement of the wind, and the departures from normals in the case of pressure, temperature, and precipitation, the total depth of snowfall, and the mean wet-bulb temperatures. The altitudes of the instruments above ground are also given.

Table II gives, for about 2,700 stations occupied by voluntary observers, the highest maximum and the lowest minimum temperatures, the mean temperature deduced from the average of all the daily maxima and minima, or other readings, as indicated by the numeral following the name of the station; the total monthly precipitation, and the total depth in inches of any snow that may have fallen. When the spaces in the snow column are left blank it indicates that no snow has fallen, but when it is possible that there may have been snow of which no record has been made, that fact is indicated by leaders, thus (....).

Table III gives, for about 30 stations furnished by the Canadian Meteorological Service, Prof. R. F. Stupart, director, the means of pressure and temperature, total precipitation and depth of snowfall, and the respective departures from normal values, except in the case of snowfall.

Table IV gives, for 26 stations selected out of 113 that maintain continuous records, the mean hourly temperatures deduced from the Richard thermographs described and figured in the Report of the Chief of the Weather Bureau, 1891–92, p. 29.

Table V gives, for 26 stations selected out of 104 that maintain continuous records, the mean hourly pressures as automatically registered by Richard barographs, except for Washington, D. C., where Foreman's barograph is in use. Both instruments are described in the Report of the Chief of the Weather Bureau, 1891–92, pp. 26 and 30.

Table VI gives, for about 130 stations, the arithmetical means of the hourly movements of the wind ending with the respective hours, as registered automatically by the Robinson anemometer, in conjunction with an electrical recording mechanism, described and illustrated in the Report of the Chief of the Weather Bureau, 1891–92, p. 19.

Table VII gives, for all stations that make observations at 8 a. m. and 8 p. m., the four component directions and the resultant directions based on these two observations only and without considering the velocity of the wind. The total movement for the whole month, as read from the dial of the Robinson anemometer, is given for each station in Table I. By adding the four components for the stations comprised in any geographical division the average resultant direction for that division can be obtained.

Table VIII gives the total number of stations in each State from which meteorological reports of any kind have been received, and the number of such stations reporting thunderstorms (T) and auroras (A) on each day of the current month.

Table IX gives, for about 70 stations, the average hourly sunshine (in percentages) as derived from the automatic records made by two essentially different types of instruments, designated, respectively, the thermometric recorder and the photographic recorder. The kind of instrument used at each station is indicated in the table by the letter T or P in the column following the name of the station.

Table X gives a record of rains whose intensity at some period of the storm's continuance equaled or exceeded the following rates:

Duration, minutes..	5	10	15	20	25	30	35	40	45	50	60	80	100	120
Rates pr. hr. (ins.)..	3.00	1.80	1.40	1.20	1.08	1.00	0.94	0.90	0.86	0.84	0.75	0.60	0.54	0.50

In the northern part of the United States, especially in the colder months of the year, rains of the intensities shown in the above table seldom occur. In all cases where no storm of sufficient intensity to entitle it to a place in the full table has occurred, the greatest rainfall of any single storm has been given, also the greatest hourly fall during that storm.

Table XI gives the record of excessive precipitation at all stations from which reports are received.

NOTES EXPLANATORY OF THE CHARTS.

Chart I.—Tracks of centers of high areas. The roman

letters show number and order of centers of high areas. The figures within the circles show the days of the month; the letters *a* and *p* indicate, respectively, the 8 a. m. and 8 p. m., seventy-fifth meridian time, observations. The queries (?) on the tracks show that the centers could not be satisfactorily located. Within each circle is given the highest barometric reading reported near the center. A blank indicates that no reports were available. A wavy line indicates the axis of a ridge of high pressure.

Chart II.—Tracks of centers of low areas. The roman letters show number and order of centers of low areas. The figures within the circles show the days of the month; the letters *a* and *p* indicate, respectively, the 8 a. m. and 8 p. m., seventy-fifth meridian time, observations. The queries (?) on the tracks show that the centers could not be satisfactorily located. Within each circle is given the lowest barometric reading reported near the center. A blank indicates that no reports were available. A wavy line indicates the axis of a trough or long oval area of low pressure.

Chart III.—Total precipitation. The scale of shades showing the depth of rainfall is given on the chart itself. For isolated stations the rainfall is given in inches and tenths, when appreciable; otherwise, a "trace" is indicated by a capital T, and no rain at all, by 0.0.

Chart IV.—Sea-level isobars and isotherms, and resultant winds. The wind directions on this Chart are the computed resultants of observations at 8 a. m. and 8 p. m., daily; the resultant duration is shown by figures attached to each arrow. The temperatures are the means of daily maxima and minima and are reduced to sea level. The pressures are the means of 8 a. m. and 8 p. m. observations, daily, and are reduced to sea level and to standard gravity. The reduction for 30 inches of the mercurial barometer, as formerly shown by the marginal figures for each degree of latitude, has already been applied.

Chart V.—Hydrographs for seven principal rivers of the United States.

Chart VI.—Surface temperatures; maximum, minimum, and mean. Lines of equal monthly mean temperature in red; lines of equal maximum temperature in black; and lines of equal minimum temperature (dotted) also in black.

Chart VII.—Percentage of sunshine. The average cloudiness at each Weather Bureau station is determined by numerous personal observations during the day. The difference between the observed cloudiness and 100, it is assumed, represents the percentage of sunshine, and the values thus obtained have been used in preparing Chart VII.

Chart VIII.—The total snowfall. This is based on the reports from all available observers and shows the depth of the snowfall during the month in inches. In general, the depth is shown by lines and areas of equal snowfall, but in some cases figures are also given for special localities.

Chart IX.—Depth of snow on ground. This chart is based essentially upon reports from regular and special observers and shows the depth of snow lying on the ground at the end of the month, which is, therefore, the accumulated excess of the snowfall over its loss by melting, evaporation, and settling.

TABLE I.—*Climatological data for Weather Bureau Stations, December, 1898.*

Stations.	Elevation of instruments: Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Pressure, in inches: Mean actual, 8 a. m. and 8 p. m. ÷ 2.	Mean reduced.	Departure from normal.	Temperature of the air, in degrees Fahrenheit: Mean max. and min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches: Total.	Departure from normal.	Days with .01, or more.	Wind: Total movement, miles.	Prevailing direction.	Maximum velocity: Miles per hour.	Direction.	Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
New England.							30.9	-0.7										76	2.55	-1.1										5.9	
Eastport	76	69	74	29.85	29.94	-.03	26.3	+0.8	46	5	34	-7	29	19	38	24	20	80	2.99	-1.0	16	8,578	w.	72	e.	5	5	13	13	6.8	19.4
Portland, Me	103	81	89	29.84	29.95	-.07	26.6	-0.8	48	30	34	-6	14	19	30	23	20	78	2.85	-0.7	13	5,574	sw.	50	e.	5	9	15	7	5.5	12.6
Northfield	872	15	65	29.00	29.99	-.06	21.0	-0.4	56	30	30	-24	14	12	44	20	17	81	1.36	-1.7	14	7,033	s.	34	s.	30	3	8	20	7.8	9.3
Boston	125	115	181	29.87	30.01	-.04	32.0	+0.9	58	30	39	0	14	25	33	28	22	69	2.19	-1.3	7	8,834	sw.	50	e.	5	14	4	13	5.3	7.7
Nantucket	14	43	54	30.02	30.03	-.03	35.7	-0.7	52	23	41	10	14	30	30	33	29	78	2.22	-2.0	9	9,364	nw.	54	se.	5	6	13	12	6.3	1.7
Woods Hole	22	51	57				33.8	-1.3	53	23	39	6	14	29	32	....	....	....	2.97	-0.5	6	9,226	sw.	48	sw.	5	15	3	13	4.9	1.0
Vineyard Haven	....	20	....	....	....	....	36.2	-1.4	56	23	42	8	14	30	30	....	....	....	2.95	-0.8	8	......	nw.	....	....	....	9	8	14	....	0.8
Block Island	27	39	48	30.01	30.04	-.02	34.6	-1.6	53	5	40	8	14	30	30	32	27	72	3.22	-0.4	9	13,695	nw.	69	e.	4	10	11	10	5.4	1.8
Narragansett	....	10	....	....	....	....	31.8	-1.0	50	*	39	1	14	24	35	....	....	....	2.61	-1.1	8	......	nw.	....	....	....	16	2	13	....	1.0
New Haven	107	118	140	29.92	30.04	-.05	31.0	-1.2	53	30	38	2	14	24	27	28	24	77	2.11	-1.3	10	6,900	sw.	54	e.	5	14	7	10	4.9	3.0
Mid. Atlan. States.							35.8	-0.5										74	2.62	-0.7										5.5	
Albany	97	84	113	29.93	30.04	-.04	29.0	+0.4	51	30	36	-5	14	22	32	26	21	78	1.02	-1.7	8	5,764	s.	60	ne.	5	6	10	15	6.9	7.3
Binghamton	875	79	90	....	....	....	27.8	-0.7	58	30	35	-3	14	21	30	....	....	....	1.45	-1.4	15	6,123	w.	34	se.	4	2	12	17	7.5	5.8
New York	314	313	346	29.71	30.06	-.04	34.4	0.0	57	30	41	12	14	28	36	31	27	75	2.93	-0.4	10	12,472	nw.	78	e.	4	9	11	11	5.8	1.1
Harrisburg	377	94	104	....	....	....	31.8	-2.6	57	30	38	11	14	26	41	....	....	....	3.16	+0.1	10	6,535	w.	44	e.	4	13	7	11	5.5	5.4
Philadelphia	117	168	184	29.95	30.08	-.05	35.9	+0.4	60	30	42	16	14	30	35	31	26	70	3.21	+0.5	12	7,857	sw.	48	se.	4	10	8	13	6.0	0.3
Atlantic City	52	68	76	30.03	30.09	-.02	36.4	0.0	56	4	43	12	14	30	28	33	30	80	2.40	-1.5	10	8,687	nw.	50	se.	4	10	9	12	5.6	0.4
Cape May	24	52	70	30.09	30.11	....	37.6	-0.3	54	4	42	21	14	33	22	....	....	....	2.53	-1.8	10	10,971	w.	67	e.	4	14	6	11	5.4	T.
Baltimore	123	68	82	29.95	30.09	-.05	36.2	-1.3	66	30	43	14	14	30	42	32	26	69	3.34	+0.2	9	4,180	w.	54	e.	4	16	5	10	4.6	0.6
Washington	112	59	76	29.99	30.12	-.04	35.6	-0.6	68	30	44	12	14	27	38	31	25	69	3.56	+0.6	10	4,677	s.	36	e.	4	15	4	12	4.9	1.6
Cape Henry	....	5	34	....	....	....	42.6	-1.3	69	30	51	18	15	35	36	....	....	....	1.54	-2.3	9	......	sw.	....	......	....	17	8	6	....	0.5
Lynchburg	685	83	88	29.36	30.13	-.03	38.8	-0.5	66	21	48	14	15	30	32	34	29	74	4.35	+1.3	9	3,246	sw.	27	nw.	10	14	10	7	4.6	T.
Norfolk	57	88	93	30.08	30.15	+.01	43.2	+0.4	70	30	52	20	15	35	34	38	34	75	1.90	-1.8	9	6,200	sw.	36	sw.	4	17	7	7	4.3	T.
Richmond	144	98	105	....	....	....	40.6	......	69	30	50	16	15	31	35	....	....	....	3.08	......	10	4,487	sw.	36	sw.	4	11	8	12	5.2	T.
S. Atlantic States.							48.0	-0.6										75	2.58	-0.9										5.5	
Charlotte	773	68	76	29.30	30.15	-.02	43.0	-0.6	68	21	51	15	15	35	28	38	31	69	2.12	-2.0	7	5,554	sw.	45	sw.	4	12	9	10	4.9	
Hatteras	11	17	86	30.14	30.15	+.01	47.6	-0.6	68	4	53	28	14	42	27	44	41	81	3.38	-2.1	11	9,948	n.	38	n.	14	11	11	9	5.2	
Kittyhawk	9	12	30	....	....	....	45.7	-0.5	68	20	55	24	10	37	27	....	....	....	2.90	-1.3	7	10,029	.....	....	.....	....	14	5	12	5.5	
Raleigh	375	93	101	29.75	30.16	-.04	43.6	-0.3	68	21	52	14	15	35	31	38	33	71	1.88	-0.8	9	4,835	sw.	36	w.	4	11	8	12	5.5	
Wilmington	78	82	90	30.09	30.18	+.02	48.4	+0.1	73	20	56	24	15	40	30	43	38	76	2.40	-0.6	10	5,752	w.	36	sw.	4	7	11	13	6.3	
Charleston	48	14	92	30.16	30.21	+.05	51.2	-0.3	71	23	58	29	14	44	27	45	40	71	2.32	-0.9	10	7,440	n.	34	sw.	4	8	12	11	5.8	
Columbia	....	5	....	....	....	....	46.8	-1.7	75	21	56	22	14	37	34	....	....	....	1.46	-1.5	8	....	sw.	....	......	....	9	6	16	....	
Augusta	180	89	103	29.98	30.17	+.01	47.8	+0.1	73	30	56	25	14	40	33	42	37	74	2.39	-1.0	11	4,614	nw.	36	sw.	4	13	6	12	5.2	
Savannah	82	63	89	30.10	30.19	+.01	51.4	-1.0	73	20	59	31	10	44	26	45	40	74	2.16	-1.0	11	6,305	sw.	31	w.	4	11	7	13	5.7	T.
Jacksonville	43	69	84	30.14	30.19	+.03	54.8	-1.2	78	3	63	33	6	46	27	50	47	84	4.74	+1.9	14	5,561	n.	36	sw.	4	11	11	9	5.1	
Florida Peninsula.							65.6	-0.6										82	2.89	+0.7										5.0	
Jupiter	28	13	30	30.13	30.16	-.01	66.2	-0.5	84	3	73	41	28	60	25	60	58	79	2.56	-0.1	8	7,700	nw.	28	s.	22	14	12	5	4.3	
Key West	22	43	50	30.13	30.15	+.03	70.5	+0.5	81	2	75	55	6	66	14	66	64	84	3.25	+1.6	6	8,202	e.	36	n.	11	15	5	5	4.9	
Tampa	36	60	67	30.13	30.17	+.01	60.0	-1.9	78	3	68	36	6	51	26	54	51	82	2.87	+0.5	9	4,974	nw.	36	sw.	4	10	11	10	5.8	
East Gulf States.							49.2	-3.3										75	3.91	-0.4										5.6	
Atlanta	1,131	92	126	28.97	30.20	.00	43.6	-1.7	67	21	50	18	14	37	31	39	34	74	3.84	-0.6	11	7,298	nw.	35	nw.	31	11	7	13	5.7	0.4
Pensacola	56	78	90	30.14	30.20	+.04	51.6	-2.9	70	3	58	26	11	45	35	47	43	78	4.05	+0.2	13	7,301	ne.	36	nw.	4	12	6	13	5.5	
Mobile	57	88	96	30.14	30.21	+.04	49.4	-3.0	70	21	57	25	11	42	32	45	43	84	3.11	-1.4	12	5,952	n.	32	w.	19	15	8	8	4.3	
Montgomery	221	100	112	29.96	30.20	+.02	48.0	-1.6	74	21	57	20	14	39	31	42	38	74	3.69	-1.0	9	5,239	ne.	38	w.	4	11	6	14	5.6	T.
Vicksburg	247	65	73	29.92	30.20	+.02	45.5	-5.1	73	30	54	21	10	37	31	40	33	66	3.33	-1.6	7	5,687	n.	38	w.	4	10	7	14	6.0	1.5
New Orleans	54	112	120	30.15	30.21	+.07	50.8	-4.7	75	30	58	30	14	44	33	46	41	76	2.03	-2.3	11	7,288	n.	35	w.	3	7	7	17	6.7	
Port Eads	....	27	....	....	....	....	55.2	-4.3	76	1	62	35	5	48	31	....	....	....	7.33	+3.9	13	....	n.	....	......	....	5	5	21	....	
West Gulf States.							45.4	-6.0										73	2.40	-0.9										5.1	
Shreveport	249	77	84	29.93	30.21	+.05	44.7	-4.8	75	29	54	18	10	36	31	38	32	65	3.07	-1.6	5	5,852	se.	39	sw.	3	12	6	13	5.3	7.0
Fort Smith	481	63	72	29.66	30.20	+.04	39.4	-3.4	74	29	49	14	10	30	41	34	28	73	1.96	-1.2	10	5,275	e.	32	ne.	18	17	3	11	4.4	2.8
Little Rock	357	98	100	29.82	30.22	+.05	40.3	-4.7	69	29	49	16	14	32	38	35	30	60	1.43	-2.9	4	6,607	nw.	35	w.	4	16	7	8	4.3	4.0
Corpus Christi	20	42	50	30.20	30.22	+.08	50.8	-8.5	73	30	58	28	10	44	28	47	44	82	1.33	0.0	9	7,584	n.	36	nw.	3	9	11	11	5.8	
Fort Worth	670	106	114	....	....	....	40.9	......	78	29	51	11	11	31	37	....	....	....	2.70	......	5	7,470	nw.	30	nw.	3	18	6	7	3.9	5.5
Galveston	54	85	96	30.14	30.19	+.05	50.4	-6.7	67	19	56	28	10	44	21	46	43	79	2.26	-1.8	10	8,324	ne.	39	nw.	3	11	8	12	5.7	T.
Palestine	510	54	61	29.66	30.22	+.05	45.0	-6.4	75	29	54	14	10	36	29	40	36	75	5.22	+1.4	7	6,030	n.	30	nw.	3	11	10	10	5.5	6.2
San Antonio	704	95	104	29.45	30.22	+.07	47.4	-7.5	75	29	57	20	10	38	32	40	33	65	1.54	-0.4	7	7,434	n.	42	n.	3	17	3	11	4.5	2.7
Ohio Val. & Tenn.							34.9	-3.3										75	2.22	-1.3										5.5	
Chattanooga	762	106	112	29.38	30.22	+.03	41.1	-2.5	69	22	50	16	14	33	29	36	30	71	2.04	-2.4	9	5,578	w.	38	w.	4	9	10	12	5.7	0.2
Knoxville	1,004	10	88	29.10	30.20	.00	37.9	-2.0	66	19	46	12	14	29	34	34	30	79	1.67	-2.4	9	6,322	sw.	50	sw.	4	12	10	9	5.1	1.6
Memphis	399	140	154	29.77	30.21	+.03	41.0	-2.6	67	29	48	14	14	34	38	36	29	65	2.96	-1.2	7	8,288	sw.	40	nw.	22	12	6	13	5.3	4.4
Nashville	545	128	134	29.58	30.18	+.02	38.6	-3.1	67	19	48	10	14	30	32	34	30	75	2.41	-1.3	7	5,197	nw.	30	sw.	4	13	8	10	4.6	3.5
Lexington	990	75	102	29.05	30.16	-.01	33.2	-4.9	63	22	42	-1	14	25	29	29	25	75	2.80	-0.6	13	9,680	s.	45	w.	4	10	10	11	5.6	7.3
Louisville	525	114	136	29.57	30.16	-.01	34.7	-3.7	62	29	42	7	14	27	31	31	26	74	2.61	-1.3	10	7,144	sw.	36	w.	4	12	7	12	5.8	5.8
Evansville	434	72	82	....	....	....	34.2	......	61	19	41	8	14	27	33	....	....	....	1.53	......	8	6,349	sw.	30	s.	29	14	6	11	4.7	2.2
Indianapolis	823	154	164	29.20	30.13	-.01	29.3	-3.8	60	30	37	-2	14	22	34	26	22	77	2.08	-1.1	9	9,601	sw.	39	sw.	29	12	3	16	6.1	7.4
Cincinnati	628	152	157	29.45	30.16	.00	32.2	-4.4	60	29	40	1	14	25	29	29	26	78	2.46	-0.7	12	7,019	sw.	34	w.	22	13	6	12	4.9	7.1
Columbus	824	87	100	29.19	30.12	-.02	30.0	-3.3	58	30	37	-1	14	23	31	27	24	83	1.09	-1.8	9	7,186	sw.	29	nw.	27	11	4	16	5.9	4.5
Pittsburg	842	116	123	29.16	30.10	-.03	32.9	-2.1	65	30	40	8	14	26	34	30	25	75	1.92	-1.0	14	5,734	nw.	30	nw.	5	5	9	17	7.1	6.8
Parkersburg	638	77	84	29.44	30.16	-.03	32.8	-4.2	66	30	41	-2	14	24	35	29	25	77	2.36	-0.9	11	5,485	sw.	32	w.	22	12	8	11	5.2	6.1
Lower Lake Region.							28.4	-2.1										77	2.73	-0.1										8.0	
Buffalo	768	178	206	29.12	29.99	-.07	29.4	-0.4	53	30	35	9	13	24	31	27	23	75	3.52	+0.2	19	17,905	w.	68	sw.	23	1	4	26	8.9	30.1
Oswego	335	76	87	29.60	29.99	-.07	28.0	-1.4	53	30	34	4	28	22	37	26	22	78	3.25	-0.1	21	11,141	sw.	37	nw.	5	1	4	26	8.5	26.8
Rochester	523	81	90	29.40	29.99	-.07	28.0	-0.6	55	30	34	6	14	22	33	26	22	77	3.01	+0.1	21	7,723	sw.	38	sw.	23	2	4	25	8.8	27.0
Erie	714	92	102	29.23	30.04	-.03	29.6	-2.8	58	30	35	10	14	24	36	27	23	79	2.84	-0.4	18	11,930	sw.	41	s.	19	0	7	24	8.2	18.8
Cleveland	762	190	201	29.19	30.05	-.04	28.9	-2.3	55	29	35	5	14	23	29	26	20	69	2.13	-0.5	13	13,950	sw.	60	w.	5	2	12	17	7.7	9.7
Sandusky	629	62	74	29.35	30.06	-.04	28.8	-3.7	56	29	34	3	14	23	30	26	22	76	2.35	-0.1	8	7,697	sw.	41	nw.	27	2	13	16	7.3	3.2
Toledo	674	122	127	29.30	30.06	-.03	27.4	-3.3	53	29	33	1	14	22	30	25	21	78	1.99	-0.4	10	9,774	sw.	36	sw.	26	6	8	17	7.2	6.3
Detroit	730	160	166	29.21	30.04	-.04	26.9	-2.6	49	29	32	4	14	22	27	25	22	83	2.75	+0.2	11	10,110	sw.	40	sw.	26	2	9	20	7.8	16.0
Upper Lake Region.							21.4	-3.2										83	1.24	-1.0										6.5	
Alpena	609	61	65	29.25	29.95	-.08	23.6	-1.2	45	29	29	2	28	18	25	22	19	84	1.22	-1.2	15	7,827	w.	35	nw.	27	1	11	19	8.3	10.9
Escanaba	612	43	57	29.28	29.98	-.05	19.2	-2.2	38	21	27	-8	31	12	28	17	14	84	0.43	-1.5	6	6,807	sw.	36	s.	28	9	13	9	5.8	4.5
Grand Haven	628	55	64	29.30	30.02	-.03	28.0	-1.6	44	29	34	8	26	22	28	26	23	83	2.15	-0.5	17	10,087	sw.	42	sw.	26	2	8	21	8.2	8.4
Marquette	734	67	95	29.10	29.94	-.09	20.6	-2.2	40	17	26	-6	31	15	21	18	16	88	1.52	-0.9	13	8,239	w.	44	s.	26	2	12	17	7.5	19.0
Port Huron	639	70	108	29.30	30.08	-.04	26.6	-1.2	48	29	32	3	14	21	26	25	23	89	3.17	+0.8	13	10,183	sw.	35	s.	28	3	11	17	7.4	15.6
Sault Ste. Marie	624	58	65	29.20	29.91	-.00	19.2	-3.4	37	18	26	-17	31	12	35	18	16	86	1.26	-0.8	16	6,860	sw.	39	nw.	27	2	5	24	8.7	14.4
Chicago	824	241	274	29.16	30.10	+.02	24.3	-5.0	46	29	31	0	31	17	32	22	20	86	1.11	-1.2	8	14,814	w.	47	s.	26	12	7	12	5.3	2.7
Milwaukee	671	106	149	29.30	30.07	-.01	21.4	-4.2	51	29	28	-5	31	15	36	19	14	73	0.58	-1.4	8	9,297	nw.	38	w.	27	14	6	11	4.5	1.7
Green Bay	617	49	57	29.33	30.05	-.01	17.4	-6.4	42	29	26	-11	31	9	35	15	11	79	0.74	-1.8	7	6,458	sw.	31	w.	27	14	11	6	4.6	6.9
Duluth	702	95	106	29.22	30.04	-.04	13.5	-4.3	43	17	22	-24	31	5	42	11	7	78	0.19	-1.2	4	6,823	sw.	45	nw.	12	13	11	7	4.6	2.5
North Dakota.							13.8	+0.6										78	0.27	-0.4										4.1	
Moorhead	935	54	60	29.02	30.12	-.03	10.2	-1.7	50	28	20	-24	31	0	50	9	7	91	0.32	-0.4	7	7,527	nw.	36	nw.	26	18	8	5	3.7	2.9
Bismarck	1,674	16	29	28.27	30.18	+.04	16.9	+2.2	50	28	27	-18	31	7	38	13	5	63	0.44	-0.2	5	7,074	nw.	36	nw.	26	16	7	8	4.5	3.6
Williston	1,872	15	31	28.05	30.18	+.01	14.2	+1.2	44	28	24	-22	13	4	38	12	9	80	0.06	-0.6	2	6,627	sw.	36	nw.	29	15	15	1	4.0	0.6
Upper Miss. Valley.							23.3	-5.2										78	0.78	-1.2										4.5	
Minneapolis	......	99	....	....	....	....	14.1	-7.8	41	17	22	-20	31	6	43	....	....	....	0.07	-1.4	5	....	nw.	....	......	...	11	14	6	....	1.5
St. Paul	837	114	124	29.13	30.11	.00	13.3	-5.5	40	17	22	-19	31	5	37	12	8	82	0.15	-1.1	6	5,478	nw.	35	nw.	26	16	9	6	4.0	1.5
La Crosse	720	70	78	....	....	....	15.8	-7.8	40	29	25	-19	31	7	31	....	....	....	0.29	-1.2	6	4,797	nw.	26	se.	26	16	9	6	4.4	2.1

TABLE I.—*Climatological data for Weather Bureau Stations, December, 1898*—Continued.

Stations.	Elevation of instruments: Barometer above sea level, feet.	Elevation of instruments: Thermometers above ground.	Elevation of instruments: Anemometer above ground.	Pressure, in inches: Mean actual, 8 a. m. and 8 p. m. ÷ 2.	Pressure: Mean reduced.	Pressure: Departure from normal.	Temperature of the air, in degrees Fahrenheit: Mean max. and min. ÷ 2.	Temperature: Departure from normal.	Temperature: Maximum.	Temperature: Date.	Temperature: Mean maximum.	Temperature: Minimum.	Temperature: Date.	Temperature: Mean minimum.	Temperature: Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches: Total.	Precipitation: Departure from normal.	Precipitation: Days with .01, or more.	Wind: Total movement, miles.	Wind: Prevailing direction.	Wind: Maximum velocity: Miles per hour.	Wind: Maximum velocity: Direction.	Wind: Maximum velocity: Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
Up. Miss. Val.—Con.																															
Davenport	599	71	79	29.43	30.12	− .01	23.2	− 4.6	52	29	31	− 6	31	15	28	21	17	81	0.59	− 1.1	6	6,481	sw.	27	w.	6	18	4	9	4.3	0.7
Des Moines	867	84	88	29.20	30.20	+ .05	20.6	− 6.2	46	28	29	−10	31	12	35	19	16	82	0.57	− 0.9	6	5,720	nw.	28	sw.	14	14	8	9	4.7	2.2
Dubuque	698	101	109	29.32	30.13	+ .02	19.2	− 6.7	46	29	27	−10	31	11	31	17	13	79	0.33	− 1.5	4	5,609	nw.	36	nw.	30	14	11	6	4.6	1.3
Keokuk	614	64	78	29.47	30.17	+ .04	26.0	− 3.8	57	29	33	− 4	31	19	31	22	17	73	1.38	− 0.6	6	6,997	sw.	26	nw.	25	16	6	9	4.4	0.9
Cairo	359	87	93	29.77	30.18	+ .03	36.3	− 2.9	64	30	44	7	14	28	43	31	27	74	1.27	− 2.1	6	7,442	n.	40	n.	4	14	8	9	4.6	3.0
Springfield, Ill.	644	82	92	29.42	30.14	− .01	27.6	− 5.2	57	29	34	2	14	21	26	24	20	75	1.83	− 0.9	4	8,020	sw.	28	n.	4	14	5	12	5.0	1.1
Hannibal	534	75	107	......	......	......	27.7	− 4.2	61	29	35	− 1	31	20	30	....	....	....	1.12	− 0.4	5	8,146	sw.	32	sw.	26	17	4	10	4.5	3.5
St. Louis	567	111	210	29.54	30.18	+ .03	32.6	− 3.0	62	29	40	3	14	25	44	28	24	75	1.03	− 1.8	6	8,814	s.	33	n.	4	16	5	10	4.5	3.5
Missouri Valley.							24.4	− 5.1										75	0.72	− 0.5										4.5	
Columbia	......	4	84	......	......	......	28.2	−10.1	66	29	38	−12	14	18	46	....	....	....	1.52	− 0.5	8	7,298	sw.	29	n.	4	15	6	10	4.9	5.4
Kansas City	963	78	95	29.14	30.22	+ .04	27.4	− 4.5	59	28	35	− 2	9	20	35	25	20	76	1.44	− 0.1	7	7,221	nw.	30	nw.	29	16	9	6	3.7	9.8
Springfield, Mo.	1,324	100	103	28.73	30.20	+ .06	32.2	− 6.4	66	29	40	2	14	24	33	28	23	74	1.44	− 1.5	8	8,200	s.	37	n.	4	14	11	6	4.3	4.3
Topeka	......	81	....	......	......	......	27.5	− 7.3	60	28	35	1	14	20	32	....	....	....	1.48	− 0.5	6	......	w.	....	......	...	13	12	6	....	6.8
Lincoln	1,199	74	84	28.85	30.22	+ .07	23.2	− 7.2	50	26	32	− 8	31	14	36	20	17	80	0.48	− 0.2	4	7,185	sw.	36	n.	29	16	9	6	4.2	2.5
Omaha	1,103	92	97	28.95	30.20	+ .02	22.0	− 4.7	48	28	30	−10	31	14	34	20	16	78	0.31	− 0.7	6	5,475	nw.	28	nw.	29	13	10	8	4.0	2.0
Sioux City	1,139	96	164	......	......	......	20.4	− 7.4	52	28	29	−14	31	12	36	....	....	....	0.06	− 1.1	4	8,338	nw.	44	nw.	24	13	10	8	4.5	1.3
Pierre	1,572	50	62	28.43	30.20	+ .03	22.2	− 2.5	51	28	32	−11	9	12	34	17	9	61	0.28	− 0.2	9	6,208	nw.	48	nw.	6	11	7	13	4.9	2.7
Huron	1,306	56	67	28.69	30.20	+ .01	17.6	− 1.6	58	28	29	−20	13	6	43	14	10	81	0.11	− 0.5	6	7,992	nw.	40	nw.	29	11	14	6	4.5	0.9
Yankton	1,234	52	58	......	......	......	23.0	+ 0.5	62	28	33	−13	31	13	42	....	....	....	0.10	− 0.7	3	6,250	w.	35	nw.	29	11	13	7	5.1	1.2
Northern Slope.							22.2	− 2.8										68	0.30	− 0.2										4.5	
Havre	2,494	46	47	27.40	30.15	.00	21.9	+ 1.3	55	27	31	−22	31	13	31	19	15	78	0.24	− 0.3	6	9,747	sw.	50	sw.	27	11	14	6	5.0	2.4
Miles City	2,372	41	49	27.56	30.19	+ .03	21.1	+ 1.8	56	27	30	−10	9	12	29	17	14	78	0.31	0.0	10	4,612	sw.	31	w.	28	8	16	7	5.4	1.9
Helena	4,108	88	93	25.96	30.36	+ .19	20.7	− 4.6	54	27	28	−12	31	13	28	18	12	68	0.28	− 0.6	7	5,642	sw.	36	sw.	27	8	10	13	5.6	3.3
Rapid City	3,251	46	50	26.66	30.18	.00	26.7	− 3.5	62	28	37	−14	9	16	37	20	14	68	0.19	− 0.1	7	5,962	nw.	39	w.	28	14	12	5	4.0	1.9
Cheyenne	6,084	58	60	24.01	30.35	+ .19	23.6	− 4.9	54	28	35	−17	9	12	36	17	3	47	0.36	+ 0.1	6	9,819	nw.	42	nw.	28	17	8	6	4.1	3.6
Lander	5,372	28	36	24.72	30.42	+ .24	15.5	− 7.9	56	27	31	−25	31	0	42	10	4	71	0.69	+ 0.2	6	2,501	se.	32	sw.	28	17	10	4	3.9	6.9
North Platte	2,826	43	52	27.16	30.27	+ .08	25.6	− 1.5	62	28	40	−12	9	12	49	19	12	64	0.03	− 0.5	2	6,491	nw.	36	nw.	6	17	13	1	3.4	0.6
Middle Slope.							28.2	− 6.8										71	1.41	+ 0.5										3.6	
Denver	5,290	79	151	24.77	30.36	+ .18	25.8	− 6.2	60	28	39	−20	9	12	40	19	9	55	0.99	+ 0.3	4	6,086	s.	38	nw.	20	21	7	3	3.2	15.5
Pueblo	4,682	74	81	25.37	30.30	+ .17	24.5	− 9.2	63	28	39	−16	31	10	45	20	12	62	1.24	+ 0.7	8	4,432	w.	40	n.	2	14	11	6	4.5	13.5
Concordia	1,398	42	47	28.66	30.23	+ .08	25.7	− 7.3	57	28	34	− 1	31	17	27	22	19	82	0.33	− 0.2	3	4,557	s.	25	n.	29	19	8	4	3.4	0.2
Dodge	2,504	44	52	27.52	30.27	+ .11	27.3	− 5.3	58	28	38	− 5	10	17	33	22	18	75	1.54	+ 0.9	7	6,856	nw.	38	nw.	3	19	9	3	3.6	5.0
Wichita	1,351	78	85	28.73	30.24	+ .11	30.6	− 7.3	62	28	39	2	14	22	29	26	21	75	2.00	+ 1.1	7	6,836	n.	38	n.	3	18	7	6	3.3	5.7
Oklahoma	1,218	54	62	28.89	30.24	+ .10	35.1	− 5.4	68	29	45	8	10	25	33	30	26	76	2.54	+ 0.1	5	6,535	n.	36	n.	3	20	1	10	3.7	0.8
Southern Slope.							33.2	− 8.8										72	2.10	+ 1.0										3.6	
Abilene	1,749	45	54	28.37	30.29	+ .11	38.7	− 8.8	78	29	49	1	10	29	39	32	25	65	2.14	+ 0.7	6	7,364	sw.	44	nw.	3	15	9	7	4.2	8.0
Amarillo	3,691	54	61	26.34	30.28	+ .12	27.6	− 8.7	64	5	36	− 1	10	19	39	25	21	79	2.06	+ 1.3	9	10,917	n.	48	n.	3	23	2	6	3.0	13.9
Southern Plateau.							40.8	− 4.2										49	0.90	− 0.1										3.2	
El Paso	3,767	10	110	26.30	30.25	+ .10	39.4	− 6.7	67	29	50	15	10	29	35	31	19	54	1.04	+ 0.5	7	9,152	nw.	52	ne.	3	18	7	6	3.4	3.3
Santa Fe	6,998	47	50	23.26	30.27	+ .12	24.0	− 6.8	46	5	33	1	24	15	27	19	10	59	0.40	− 0.4	4	5,207	ne.	36	ne.	18	20	7	4	3.0	5.3
Flagstaff	6,885	12	25	23.40	30.34	......	24.2	......	54	5	37	−10	12	11	43	20	....	....	1.37	......	5	......	e.	....	......	...	...	...	...	2.8	....
Phenix	1,076	47	57	29.00	30.16	+ .04	48.8	− 3.8	73	1	61	28	31	37	33	40	28	51	1.70	+ 0.6	4	3,064	e.	26	e.	9	20	4	7	3.5	T.
Yuma	139	16	50	29.98	30.13	+ .07	52.0	− 4.0	74	2	62	32	11	42	32	42	27	44	1.16	+ 0.7	4	5,112	n.	36	n.	23	18	6	7	3.6	
Independence	3,907	10	58	26.15	30.22	+ .10	39.7	+ 0.4	68	28	51	19	31	28	39	30	12	35	0.20	− 1.8	1	6,156	nw.	66	nw.	29	22	6	3	2.6	2.3
Middle Plateau.							27.8	− 5.1										65	0.32	− 0.9										4.4	
Carson City	4,720	82	92	25.42	30.34	+ .19	30.8	− 3.9	57	1	43	4	10	18	37	25	15	54	0.13	− 2.1	2	3,508	ne.	47	sw.	28	16	12	3	3.2	0.1
Winnemucca	4,340	59	70	25.85	30.40	+ .19	27.3	− 3.8	52	28	38	0	11	16	36	23	17	68	1.05	− 0.2	5	7,178	n.	52	n.	8	12	11	8	4.5	6.4
Salt Lake City	4,344	83	90	25.85	30.46	+ .22	25.2	− 7.6	47	28	33	6	23	17	25	22	17	73	1.28	− 0.4	9	3,799	se.	48	ne.	8	10	11	10	5.4	11.3
Northern Plateau.							22.7	− 8.1										81	0.79	− 1.2										6.3	
Baker City	3,470	49	55	26.66	30.43	+ .26	22.0	− 6.5	42	1	30	− 3	10	14	23	18	14	75	0.71	− 1.0	8	3,467	s.	18	se.	19	11	3	17	5.9	6.8
Boise	2,736	61	68	27.46	30.45	+ .21	25.6	− 7.5	47	19	33	5	11	18	22	24	19	76	0.71	− 1.2	11	2,570	se.	22	nw.	28	9	8	14	5.8	5.5
Idaho Falls	4,742	10	56	25.44	30.54	+ .31	12.4	−10.6	39	28	22	−19	9	3	32	11	9	89	0.76	− 0.8	9	5,773	n.	42	s.	28	9	4	18	6.8	8.1
Spokane	1,943	99	107	28.19	30.35	+ .23	24.5	− 6.8	50	27	30	− 2	13	18	20	24	21	85	0.94	− 1.6	7	3,543	sw.	30	sw.	27	12	4	15	6.0	8.3
Walla Walla	1,018	65	73	29.25	30.40	+ .31	28.8	− 8.9	63	27	34	− 2	12	23	30	26	23	82	0.85	− 1.3	10	3,543	s.	30	sw.	19	3	14	14	7.1	3.4
N. Pac. Coast Reg.							40.1	− 1.9										82	6.74	− 2.2										6.7	
Fort Canby	179	10	34	29.97	30.17	+ .21	43.4	− 0.4	58	7	47	32	30	40	13	41	36	77	8.84	− 1.1	19	12,300	se.	78	se.	18	9	5	17	6.5	T.
Neah	50	7	24	30.11	30.17	+ .24	41.8	− 1.2	57	27	45	28	30	38	12	40	38	86	12.66	− 3.7	19	7,209	e.	45	w.	28	6	7	18	7.0	5.0
Port Crescent	256	15	20	......	......	......	39.4	0.0	58	27	45	27	12	34	23	....	....	....	4.41	− 2.5	19	2,762	e.	24	sw.	19	4	11	16	7.2	5.1
Pysht	......	5	....	......	......	......	......	......	....	....	....	....	....	....	....	....	....	....	......	......	....	......	......	....	......	...	...	...	...	....	....
Seattle	119	114	121	30.08	30.21	+ .18	40.4	− 1.4	58	27	45	27	12	36	19	38	36	84	4.12	− 1.4	15	4,047	se.	27	s.	19	6	8	17	6.7	12.0
Tacoma	213	113	120	......	......	......	38.5	− 2.4	60	27	44	22	6	34	24	....	....	....	4.73	− 2.7	15	3,883	sw.	29	s.	1	7	4	20	7.4	7.5
Astoria	......	18	....	......	......	......	41.8	− 2.2	55	27	46	32	12	37	14	....	....	....	11.19	0.0	19	......	e.	....	......	...	8	3	20	....	0.5
Portland, Oreg.	153	203	213	30.09	30.26	+ .18	37.5	− 3.8	55	27	42	21	12	33	17	35	30	76	4.29	− 3.5	16	6,535	se.	34	s.	19	8	6	17	6.5	5.7
Roseburg	521	56	67	29.67	30.25	+ .13	38.2	− 3.8	58	19	44	20	12	32	27	36	34	88	3.71	− 2.7	13	2,017	e.	27	w.	19	8	12	11	5.7	10.0
Mid. Pac. C'st Reg.							47.2	− 1.4										66	1.93	− 3.7										4.7	
Eureka	64	60	69	30.14	30.20	+ .12	46.2	− 1.6	63	12	54	32	11	39	28	43	38	76	3.17	− 5.0	13	2,919	nw.	36	se.	31	12	8	11	5.1	
Mount Tamalpais	2,375	11	18	27.69	30.21	......	45.7	......	63	3	51	30	30	40	23	38	27	54	1.42	......	4	15,901	ne.	62	nw.	28	12	7	12	4.7	T.
Red Bluff	334	54	58	29.89	30.25	+ .12	45.7	− 1.0	68	7	55	26	30	36	29	40	31	62	1.69	− 3.6	3	4,186	n.	27	n.	8	20	6	5	3.2	
Sacramento	71	106	117	30.15	30.23	+ .10	44.2	− 2.9	68	7	52	28	12	35	31	40	32	67	2.30	− 1.8	4	5,215	n.	31	ne.	9	9	12	10	5.7	
San Francisco	153	161	167	30.06	30.22	+ .10	49.7	− 1.7	66	7	55	38	31	44	18	45	40	70	1.62	− 3.4	4	5,117	n.	44	ne.	9	10	13	8	4.7	
Point Reyes Light	......	12	....	......	......	......	50.0	+ 0.1	67	5	56	36	31	44	23	....	....	....	0.85	− 4.5	4	......	nw.	....	......	...	11	7	13	....	
S. Pac. Coast Reg.							52.9	+ 0.2										56	0.52	− 2.6										3.8	
Fresno	332	67	70	29.82	30.18	+ .04	45.2	− 1.1	68	3	55	26	12	35	30	40	32	66	0.43	− 1.1	4	2,566	nw.	20	nw.	29	12	5	14	5.6	
Los Angeles	330	74	82	29.75	30.11	+ .03	56.8	+ 1.4	83	2	69	34	11	45	34	46	35	52	0.12	− 3.9	3	3,006	w.	22	nw.	30	14	13	4	3.6	
San Diego	87	94	102	30.00	30.10	+ .02	56.6	+ 0.8	79	26	64	43	24	50	27	48	40	59	0.87	− 1.3	6	3,685	ne.	33	se.	14	26	2	3	2.6	
San Luis Obispo	201	10	46	29.95	30.17	+ .08	53.1	− 0.3	81	3	67	27	13	40	46	43	31	48	0.64	− 3.9	2	3,850	n.	26	n.	21	19	5	7	3.5	
West Indies.																															
Basseterre	29	41	54	30.03	30.06	......	76.8	......	85	12	82	67	31	71	16	70	69	81	3.69	......	22	7,003	e.	30	se.	31	12	18	1	4.7	
Bridgetown	30	57	65	29.98	30.01	......	78.0	......	85	4	84	69	31	72	14	72	70	83	3.35	......	22	6,118	e.	25	e.	8	1	22	8	6.3	
Colon	23	...	...	29.88	29.91	......	79.4	......	87	2	84	69	21	73	16	75	74	86	7.73	......	20	5,276	ne.	20	n.	28	8	16	7	5.3	
Kingston	286	38	52	29.72	30.03	......	76.3	......	88	30	85	64	17	68	20	68	66	81	0.19	......	7	4,239	ne.	26	se.	22	6	18	7	5.3	
Port of Spain	40	65	66	29.92	29.96	......	78.0	......	89	5	85	67	19	71	18	72	70	83	3.07	......	19	2,757	ne.	22	e.	1	3	21	7	6.6	
Roseau	25	38	46	30.00	30.02	......	78.0	......	88	1	85	68	23	71	19	70	68	80	4.18	......	21	3,316	ne.	20	ne.	16	15	13	3	4.1	
San Juan	82	109	117	29.99	30.07	......	75.9	......	85	12	82	66	19	70	17	71	69	85	5.34	......	20	4,459	e.	24	e.	14	22	9	0	2.9	
Santiago de Cuba	82	45	51	29.95	30.05	......	77.5	......	88	16	86	65	23	69	20	69	67	80	0.18	......	4	3,102*	ne.	15	n.	5	20	11	0	3.2	
Santo Domingo	59	82	88	30.02	30.08	......	74.6	......	87	6	82	62	22	67	20	69	68	90	3.81	......	18	2,886	n.	13	e.	3	12	18	1	3.6	
Willemstad	75	39	46	29.90	29.97	......	78.6	......	85	1	83	70	8	74	14	73	71	83	1.88	......	19	7,176	e.	23	e.	31	10	21	0	4.2	
Alaska.																															
Sitka	90	4	22	29.64	29.74	......	37.6	......	59	7	42	11	31	33	23	35	31	80	10.99	......	23	6,780	e.	32	s.	22	0	4	27	9.1	12.2

NOTE.—The data at stations having no departures are not used in computing the district averages. Letters of the alphabet denote number of days missing from the record. * Two or more dates. † Received too late to be considered in departures, etc.

TABLE II.—*Meteorological record of voluntary and other cooperating observers, December, 1898.*

Stations.	Temperature. (Fahrenheit.) Maximum.	Temperature. (Fahrenheit.) Minimum.	Temperature. (Fahrenheit.) Mean.	Precipitation. Rain and melted snow.	Precipitation. Total depth of snow.
	°	°	°	Ins.	Ins.
Alabama.					
Alco†	75	21	49.3	5.98	
Ashville†	68	13	41.9	2.12	
Bermuda†	78	22	49.8	5.25	
Birmingham†	70	15	45.0	2.17	
Bridgeport†	......	......	......	1.99	
Citronelle†	70	23	49.2	5.33	
Clanton†	70	18	43.2	......	0.5
Decatur†	69	14	41.6	2.04	1.0
Demopolis				2.66	
Elba	73c	20c	47.4c	8.25	
Eufaula a†	75	21	47.4	6.01	
Eufaula b	......	......	......	5.67	
Evergreen	......	20	......	5.70	
Florence a†				2.45	1.0
Florence b†	70	12	40.6	2.09	1.2
Gadsden	70	14	42.0	2.04	
Goodwater	......	......	......	2.20	T.
Greensboro†	71	18	43.7	2.76	1.0
Hamilton	......	......	......	1.51	1.0
Healing Springs	......	......	......	5.20	
Highland Home†	72	22	48.2	5.23	
Jasper				2.87	T.
Lock No. 4	69	15	41.6	2.01	T.
Madison Station†	......	......	......	2.38	1.0
Maplegrove	69	13	40.4	1.73	
Marion†	64			3.90	T.
Mount Willing†	75	19	49.2	4.70	
Newbern†	70	18	45.0	2.96	T.
Newton	70	20	47.6	6.65	
Oneonta	70	10	41.8	2.62	T.
Opelika†	76	20	45.0	7.66	3.0
Oxanna	66	14	43.0	1.75	0.5
Pineapple	72	20	46.4	3.85	
Pushmataha†	66	19	43.8	4.58	
Riverton†	70	10	39.0	4.06	4.0
Rockmills	70	13	45.6	4.30	
Scottsboro†	68	15	39.6	4.43	T.
Selma†	75	19	46.6	3.13	T.
Sturdevant	......	......	......	3.85	0.4
Talladega	71	14	43.4	1.60	0.5
Tallassee				3.93	
Thomasville	74	19	46.2	3.39	
Tuscaloosa†	70	17	42.7	3.43	......
Union†				4.40	T.
Union Springs†	73	20	46.4	6.27	
Uniontown†	72	21	47.6	3.72	
Valleyhead	67	9	40.0	......	......
Warrior				1.70	
Wetumpka	74	17	44.8	3.87	1.0
Wilsonville†	......	......	......	1.65	T.
Arizona.					
Arizona Canal Co. Dam.	78	26	51.5	2.29	4.0
Benson*1	61	33	44.7	0.85	
Bisbee†	67	24	42.0	2.90	1.0
Buckeye†	77	21	50.2	1.80	
Casa Grande*1	80	36	53.2	1.42	
Champie Camp	84	28	49.2	2.10	10.0
Congress	70	28	48.4	1.35	......
Dragoon	......	......	......	1.40	
Dragoon Summit*5	65	13	37.1	2.28	1.8
Dudleyville	71	21	43.3	2.89	8.0
Empire Ranch				0.74	......
Fort Apache	58	7	31.7	0.80	6.8
Fort Defiance	48	−16	19.1	1.40	14.0
Fort Grant†	79	16	45.0	1.30	
Fort Huachuca†	67	22	41.4	0.58	......
Fort Mohave	78	22	47.8	0.50	T.
Gilabend a*1	70	32	49.1	1.10	
Holbrook†	54	−21	18.6	1.15	11.0
Hot Springs	71	29	49.0	2.75	
Jerome	59	16	38.2	2.60	26.0
Lochiel*1	65	24	41.5	1.56	
Maricopa*1	76	31	51.0	2.12	
Mesa†	69	28	47.0	2.39	......
Mount Huachuca	62	19	39.9	3.43	
Music Mountain	67	9	38.6	0.16	2.2
Natural Bridge				3.00	30.0
Oracle	68	21	41.6	3.12	
Oro				2.13	
Oro Blanco	70	27	47.8	1.75	
Pantano*1	70	30	46.2	1.32	0.5
Parker	81	19	47.8	1.37	
Peoria	68	30	47.8	2.75	3.0
Phenix	69	23	45.9	1.98	T.
Pima	72	18	41.4	1.66	7.0
Pinal Ranch				3.13	21.0
Prescott	62	−6	34.4	1.25	14.5
San Carlos†	78	1	38.3	0.80	8.0
San Simon*1	68	15	37.1	0.53	2.0
Signal†	71	22	45.0	1.38	
Snowflake	55	−20	21.4	1.08	14.5
Strawberry	56	−7	30.4	2.90	29.0
Sulphur Spring Valley				1.31	1.2
Texas Hill*1	79	38	49.0	1.10	
Tombstone	66	22	42.2	1.29	T.
Tuba	64	−12	23.7	......	......
Arizona—Cont'd.					
Tucson†	74	22	47.2	1.63	
Walnut Grove	......	......	......	1.70	17.0
White Hills	65	18	40.3	0.50	6.0
Willcox	......	......	......	1.37	5.0
Williams	62	1	28.6	2.10	21.0
Winslow	58	−19	19.4	0.85	8.5
Yarnell	......	......	......	1.60	16.0
Arkansas.					
Amity	73	13	40.6	1.30	0.3
Arkansas City†	......	......	......	3.60	5.5
Blanchard Springs†	75	12	42.0	2.32	3.5
Brinkley	67	12	40.6	1.50	T.
Camden a†	......	......	......	3.21	4.5
Camden b†	74	13	41.2	2.08	4.0
Canton*1	66	0	36.5	......	......
Conway	73	10	40.1	1.53	4.5
Corning	66	−1	35.4	2.00	3.0
Dallas	70	10	38.3	1.53	4.3
Dardanelle	......	......	......	1.70	4.0
Elon†	73	14	42.8	1.88	3.8
Fayetteville†	67	4	35.8	1.57	8.5
Fulton†	......	......	......	2.10	
Hardy	65	0	37.0	1.96	3.2
Helena a†	......	......	......	4.27	4.5
Helena b	70	18	43.2	3.39	4.5
Hot Springs a	73	10	40.1	1.65	1.0
Hot Springs b	......	......	......	1.81	1.8
Jonesboro	68	16	39.2	2.63	1.0
Keesees Ferry†	69	−4	37.8	2.05	4.1
Lacrosse†g	66	10	36.4	......	......
Lonoke*1	70	14	40.6	2.00	2.0
Luna Landing*6	72c	18	43.1c	......	......
Lutherville*1	70	18	40.8	......	......
Malvern†	71	12	41.2	1.50	T.
Marianna*1	70	16	41.6	......	......
Marvell	68	14	41.4	2.94	2.5
Monticello h	75	22	45.4	0.64	0.7
Mossville	64	7	33.6	3.68	2.9
Mount Nebo	65	11	37.0	1.73	6.5
New Gascony	70	15	41.8	1.61	1.0
Newport a†	......	......	......	2.79	0.5
Newport b	67	4	36.2	0.80	1.5
Newport c g	63	8	39.2	2.56	0.5
Oregon	64	6	34.0	......	......
Osceola	64	8	38.0	3.31	2.5
Ozark†	72	15	40.0	1.75	3.0
Picayune†	75	6	40.4	1.11	3.0
Pinebluff†	71	16	41.9	2.24	6.0
Pocahontas	64	5	36.6	1.93	3.0
Pond	67	−3	33.4	1.73	10.0
Powell	72	2	36.2	1.72	2.0
Prescott	74	13	42.6	1.44	1.5
Rison	74	13	42.2	1.11	4.0
Silver Springs†	67	1	35.7	1.16	6.1
Spielerville	74	8	38.2	2.19	13.0
Stuttgart†	69	12	40.0	1.79	2.0
Texarkana†	76	10	41.8	1.21	1.1
Warren†	71	15	42.0	1.97	5.0
Washington	73	15	41.4	1.74	2.0
Wiggs*1	68	12	42.4	1.33	2.2
Winslow	60	5	32.8	3.38	11.0
Witts Springs†	63	5	37.0	1.97	2.5
California.					
Agnew	72	26	48.2	0.86	
Anada	69	14	38.8	4.35	11.0
Arlington Heights	80	31	52.4	1.38	1.2
Ballast Point L. H	......	......	......	0.85	
Bear Valley	......	......	......	3.44	3.5
Berkeley	65	34	48.2	1.22	
Bishop	73	10	39.4	0.11	0.8
Blue Lakes City	68	19	42.6	2.32	
Boca*1	48	−12	21.6	1.58	7.0
Bodie†	49	−5	21.8	0.14	2.5
Bowmans Dam*1	64	7	35.6	3.22	12.0
Caliente*1	70	35	50.0	0.68	
Calloway	74	22	48.4	0.07	
Campbell	64	23	44.6	0.63	
Cape Mendocino L. H	......	......	......	3.00	
Cedarville†	52	2	26.3	1.68	13.0
Centerville*1	72	34	50.7	1.65	
Chico*1	70	28	46.0	1.81	
Cisco*1	46	2	29.0	1.10	9.0
Claremont	76	26	50.5	0.75	
Corning*1	62	23	41.6	1.05	
Coronado	77	50	59.0	......	
Craftonville	81	28	51.6	0.38	
Crescent City	63	30	46.4	6.07	
Delano*1	63	25	44.2	0.30	
Delta*1	68	22	45.4	2.00	
Drytown	66	25	43.6	2.57	
Dunnigan*1	66	26	46.5	1.28	
Durham*1	67	24	43.7	1.52	
East Brother L. H	......	......	......	1.05	
Edmanton*1	55	12	33.8	1.94	6.0
Elsinore	87	26	52.4	1.38	
Escondido	81	22	49.1	1.48	
California—Cont'd.					
Fallbrook*1	80	32c	53.3	1.04	
Folsom City*1	66	29	45.2	2.47	
Fordyce Dam	......	......	......	3.70	28.0
Fort Bragg	......	......	......	2.14	
Fort Romie	78	22	47.3	0.51	
Fort Ross	68	34	49.9	1.62	
Fort Tejon	......	......	......	0.73	
Georgetown	64	22	44.5	3.35	T.
Glendora	......	......	......	0.34	
Goshen*5	66	21	46.4	0.03	
Grand Island*5	70	24	46.1	0.99	
Grass Valley	......	......	......	2.73	
Greenville†	56	3	32.5	1.54	2.0
Healdsburg*1	78	22	45.4	1.14	
Hollister	73	20	45.6	1.32	
Hueneme (near)	82	32	56.7	T.	
Humboldt L. H	......	......	......	3.51	
Hydesville	......	......	......	2.27	
Indio*1	78	28	51.0	1.00	
Iowa Hill*1	66	27	45.7	2.84	
Jackson	62	26	43.0	2.70	
Jolon	......	......	......	0.40	
Keene*1	64	30	44.7	0.62	
Kennedy Gold Mine	63	25	43.4	3.19	
Kernville	......	......	......	0.42	
King City*1	68	22	44.2	0.27	
Kingsburg*5	60	23	44.3	0.29	
Lagrange*5	66	28	45.8	1.40	
Laporte*†1	55	8	33.4	3.36	13.5
Las Fuentes Ranch	......	......	......	0.23	
Lemoore a*1	62	18	41.5	0.15	
Lick Observatory	57	22	43.3	2.13	T.
Limekiln	68	27	46.2	......	
Lime Point L. H	......	......	......	2.11	
Lodi	63	21	43.2	1.93	
Los Alamos	......	......	......	0.85	
Los Gatos b	62	32	46.2	0.96	
Malakoff Mine	68	20	44.0	4.10	
Mammoth Tank*1	76	33	51.4	T.	
Manzana	68	23	43.5	0.50	
Mare Island L. H	......	......	......	1.19	
Merced*1	67	26	44.8	0.42	
Mills College	......	......	......	1.64	
Milo	......	......	......	1.17	
Milton (near)*1	64	27	44.3	2.35	
Modesto*1	73	27	46.2	0.88	
Mohave*1	66	20	42.4	0.29	
Mokelumne Hill*3	......	28	41.9	2.50	
Monterey*1	67	29	51.6	0.98	
Mountain View	......	......	......	1.02	
Mount Frazier	......	......	......	0.88	10.0
Napa b	74	25	47.4	0.97	
Needles	70	27	49.5	0.73	
Nevada City	62	19	41.4	2.27	
Newhall*1	78	28	49.4	0.22	
North Ontario	78	28	50.6	0.55	
North San Juan*1	68	18	40.1	1.88	
Oakland a	67	32	46.9	1.48	
Ogilby*1	75	35	52.3	T.	
Oleta*1	66	25	40.9	2.24	
Orland*1	66	28	45.0	1.22	
Palermo	70	24	44.0	1.55	
Paso Robles b	68	20	44.8	0.27	
Peachland*5	70	26	46.2	1.38	
Piedras Blancas L. H	......	......	......	0.46	
Pigeon Point L. H	......	......	......	0.41	
Pilot Creek	......	......	......	3.89	4.0
Pine Crest	78	39	57.8	0.39	
Placerville*1	62	19	39.8	2.80	
Point Ano Nuevo L. H	......	......	......	0.38	
Point Arena L. H	......	......	......	3.24	
Point Bonita L. H	......	......	......	1.68	
Point Conception L. H	......	......	......	0.82	
Point Firmin L. H	......	......	......	0.35	
Point Hueneme L. H	......	......	......	0.36	
Point Lobos	64	36	48.8	1.61	
Point Loma L. H	......	......	......	0.52	
Point Montara L. H	......	......	......	1.92	
Point Pinos L. H	......	......	......	1.36	
Point Reyes L. H	......	......	......	0.85	
Point Sur L. H	......	......	......	1.27	
Pomona (near)	80	27	52.5	0.51	
Poway*3	84	32	46.6	1.87	
Quincy†	52	6	32.6	1.56	2.0
Redding b†	69	24	45.5	1.78	T.
Redlands	81	29	52.4	0.40	2.0
Represa	62	24	44.4	2.62	
Rio Vista	68	21	43.6	1.47	
Roe Island L. H	......	......	......	0.89	
Rosewood	65	17	40.6	1.78	3.0
Sacramento a	68	26	43.6	1.98	
Salinas*1	72	27	46.4	1.40	
Salton*1	75	35	46.2	0.59	
San Bernardino†	79	25	50.6	0.44	T.
San Jacinto	75	24	48.6	1.38	
San Leandro*1	78	34	52.3	1.58	

TABLE II.—*Meteorological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
California—Cont'd.	°	°	°	Ins.	Ins.
San Luis L. H.	......	......	......	0.83	
San Mateo *1	67	33	47.6	1.35	
San Miguel *1	65	18	43.4	0.36	
Santa Barbara a	80	38	55.6	0.36	
Santa Barbara L. H.	......	......	......	0.38	
Santa Clara a	......	......	......	0.86	
Santa Cruz b †	76	26	48.2	2.24	
Santa Cruz L. H.	......	......	......	1.97	
Santa Maria	80	30	54.8	0.64	
Santa Monica *1	80	36	55.8	0.15	
Santa Paula	75	28	52.2	0.26	
Santa Rosa *1	67	23	46.8	1.20	
Saticoy	......	......	......	0.16	
Shasta	67	23	46.3	2.15	
Sierra Madre	74	35	54.0	1.63	
Sonoma	......	......	......	0.99	
S. E. Farrallone L. H.	......	......	......	0.92	
Stanford University	64	26	44.7	0.60	
Stockton a	64	23	42.0	1.50	
Summerdale †	59	16	37.8	2.64	1.0
Susanville †	50	10	29.0	0.65	2.0
Sutter Creek *5	58	20	38.2	2.26	
Tehama *1	67	29	46.6	1.76	
Templeton *1	80	18	41.6	0.50	
Thermalito	74	26	45.5	1.67	
Trinidad L. H.	......	......	......	4.90	
Truckee *1	56	− 6	21.5	1.50	15.0
Tulare b	......	......	......	0.23	
Tulare c	72	18	45.2	0.19	
Turlock	......	......	......	1.20	
Ukiah	62	20	42.0	2.41	
Upperlake	69	21	44.2	1.34	
Upper Mattole *1	67	26	46.1	5.08	0.5
Vacaville a *1	72	26	46.1	1.30	
Ventura †	83	30	53.0	0.16	
Visalia *1	83	21	43.1	0.07	
Volcano Springs *1	78	30	46.2	0.47	
Walnut Creek	64	22	46.0	1.52	
West Palmdale	......	......	......	0.87	
Westpoint	......	......	......	2.56	0.5
Wheatland	67	24	42.2	1.78	
Williams *1	70	26	45.6	0.94	
Wilmington *1	78	40	54.7	0.50	
Wire Bridge *5	63	23	43.7	2.63	
Yerba Buena L. H.	......	......	......	1.45	
Yreka †	52	14	33.6	1.04	1.5
Colorado.					
Altman	39	−13	13.8	......	......
Antlers	45	− 5	19.4	0.19	2.0
Arkins	......	......	......	0.50	......
Boulder	60	− 9	29.3	1.30	18.0
Boxelder	......	......	......	0.17	3.0
Breckenridge †	34	−29	7.4	1.34	25.9
Canyon †	64	−14	31.2	1.05	13.8
Castlerock	60	−22	19.8	0.99	15.0
Cedaredge	47	− 4	22.1	0.24	2.8
Cheyenne Wells	68	−17	26.1	0.48	2.7
Collbran	......	......	......	0.55	8.0
Colorado Springs †	62	−17	25.0	0.43	8.0
Cope	63	−17	25.8	0.39	6.0
Delta	56	− 9	20.6	0.08	......
Dumont †	......	......	......	0.82	13.0
Durango	47	−12	19.4	3.22	37.9
Fairview	51	−25	19.6	0.56	9.0
Fort Collins †	55	−22	23.6	0.17	3.5
Fort Morgan	51	−17	21.2	0.11	1.5
Fox	......	......	......	0.25	4.0
Garnett	40	−40	1.0	0.49	8.0
Georgetown	52	−13	22.1	......	......
Gleneyrie †	58	−14	25.6	0.70	10.5
Grand Junction †	48	−11	23.6	0.31	4.8
Greeley	55	−23	21.3	0.37	5.0
Gunnison	43	−34	1.2	0.30	4.8
Hamps	58	−19	21.4	0.72	9.5
Hoehne	61	−18	21.2	1.85	17.5
Holly	......	......	......	1.36	4.0
Holyoke	......	......	......	0.22	2.2
Holyoke (near)	66	−20	24.6	0.18	3.0
Hugo	......	......	......	0.35	5.0
Husted †	60	−19	24.3	0.50	6.5
Lake Moraine	46	−15	16.6	1.31	18.5
Lamar †	62	−12	26.4	1.30	6.0
Laporte	......	......	......	0.40	6.0
Las Animas †	57	−12d	25.6	0.39	5.0
Leadville (near) *†1	38	−10	14.8	0.96	14.2
Leroy †	62	−13	26.8	0.27	4.0
Longs Peak	51	−24	19.4	0.60	9.0
Loveland	......	......	......	0.47	7.0
Mancos	47	−16	20.6	1.07	10.0
Meeker	46	−28	10.2	0.52	5.9
Millbrook	48	−16	21.7	1.33	20.5
Minneapolis †	61	− 9	24.0	1.53	11.5
Moraine †	45	−23	20.3	0.55	7.0
Pagoda †	47	−23	10.8	1.32	16.0
Parachute	41	−17	20.1	0.70	8.0
Perry Park	......	......	......	0.69	......

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Colorado—Cont'd.	°	°	°	Ins.	Ins.
Rockyford	64	−17	24.2	0.83	8.0
Ruby	......	......	......	3.58	53.0
Saguache †	38	−26	10.5	0.40	6.0
Salida	55	−13	20.8	0.60	9.5
San Luis †	40	−26	10.0	0.36	5.3
Santa Clara *1	48	−15	23.0	4.18	53.0
Seguro	50	−19	17.6	1.58	22.5
Seibert †	......	......	......	0.27	3.5
Smoky Hill Mine	60	−21	24.5	1.18	16.0
Springfield	......	......	......	0.70	9.0
Stamford *1	56	−20	14.7	1.59	27.0
Steamboat Springs	40	−22	13.9	1.47	22.0
Strickler Tunnel	......	......	......	0.84	14.5
Trinidad	......	......	......	1.60	26.0
T. S. Ranch †	45	− 2	21.9	0.61	6.4
Vilas	......	......	......	0.97	3.0
Wagon Wheel	41	−31	2.8	0.35	7.0
Wallet	......	......	......	0.73	8.0
Wray †	66	−19	25.0	0.29	4.0
Yuma	......	......	......	1.10	12.0
Connecticut.					
Bridgeport	55	− 6	28.8	3.03	6.1
Canton †	52	−10	26.1	3.78	13.5
Colchester	55	0	30.1	2.63	4.0
Falls Village	......	......	......	2.42	10.2
Greenfield Hill	......	......	......	3.01	2.8
Hartford a	48	2	28.9	2.04	4.0
Hartford b	......	......	......	4.03	7.0
Hawleyville	......	− 3	......	2.02	6.5
Lake Konomoc	......	......	......	2.68	......
Middletown *1	51	2	31.9	2.21	1.2
New London †	45	2	30.2	1.85	1.0
North Grosvenor Dale	54	−13	30.9	2.99	......
Norwalk	54	− 8	28.6	3.26	5.0
Pomfret	57	− 1	29.2	2.21	6.7
Southington	49	− 8	28.6	1.60	2.0
South Manchester	......	......	......	4.25	10.0
Storrs	53	− 4	27.3	1.96	4.8
Voluntown †	54	− 3	30.1	2.03	2.0
Wallingford	......	......	......	2.16	1.0
Waterbury	52	− 5	27.5	3.86	12.0
West Cornwall †	47	− 5	27.2	2.17	13.5
West Simsbury	......	......	......	3.42	9.0
Winsted	50	− 3	25.8	......	......
Delaware.					
Dover	68	9	35.7	2.98	......
Milford	65	17	39.4	3.19	
Millsboro	65	6	37.0	3.11	1.0
Newark	58	12	33.4	4.17	0.2
Seaford	66	13	37.7	3.97	2.2
District of Columbia.					
Distributing Reservoir *5	65	10	37.9	2.76	......
Receiving Reservoir *5	64	11	35.6	2.86	......
West Washington	72	8	34.4	3.86	1.5
Florida.					
Archer †	80	25	55.8	3.72	
Bartow	......	31	......	3.04	
Boca Raton	83	40	68.4	2.89	
Brooksville †	78	32	57.6	2.96	
Clermont	82	34	59.2	3.75	
Crawfordville	79	21	52.3	5.54	
De Funiak Springs	76	22	49.8	4.52	
Earnestville	81	32	58.6	4.64	
Estero *1	80	38	63.5	......	
Eustis †	84	32	59.3	2.38	
Federal Point †	79	29	55.1	3.15	
Fort Meade	86	26	59.9	1.97	
Gainesville	78	30	53.4	3.31	
Grasmere †	78	30	57.4	3.73	
Haywood	......	......	......	9.40	
Homeland	81	27	61.1	......	
Huntington	79	32	55.7	2.53	
Jasper	75	28	52.8	5.52	
Kissimmee	80	32	60.8	3.02	
Lake Butler	80	27	55.4	4.93	
Lake City †	78	27	54.6	5.52	
Lakemont	87	32	63.0	2.04	
Lemon City	82	40	67.4	1.50	
Macclenny †	81	28	54.0	5.23	
Manatee	81	32	59.6	1.89	
Merritts Island	78	40	61.3	3.46	
Myers †	81	37	63.8	3.12	
New Smyrna	80	30	57.8	3.67	
Oakhill *1	77	39	61.9	......	
Ocala †	90	26	57.5	4.19	
Orange City	81	28	58.2	2.54	
Orange Park	77	28	53.8	3.74	
Orlando †	81	35	59.0	3.68	
Plant City	84	30	60.2	3.24	
St. Andrews	......	27	......	11.80	
St. Francis †	81	26	57.6	2.74	
St. Francis Barracks	78	33	53.2	3.82	
Sebastian	79	38	61.3	6.58	
Stephensville	......	......	......	2.50	
Switzerland *1	78	31	53.2	4.00	
Tallahassee †	76	27	51.1	5.75	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Florida—Cont'd.	°	°	°	Ins.	Ins.
Tarpon Springs †	82	34	59.1	5.15	
Wausau	76	25	50.8	8.70	
Georgia.					
Adairsville	67	10	40.5	1.87	T.
Albany †	74	24	48.6	5.33	
Allentown †	76	22	48.1	2.99	0.2
Americus †	75c	20c	47.2c	4.80	
Athens b †	67	25	43.8	3.81	
Bellville	......	......	......	5.14	
Blakely †	73	25	50.0	5.64	
Canton †	......	......	......	1.41	
Cartersville	76	14	43.0	......	
Cedartown	70c	12c	41.4c	1.24	T.
Clayton †	64	10	40.0	4.39	0.5
Columbus	78	23	51.8	6.40	
Covington	68	13	40.8	4.85	1.0
Crescent	......	......	......	4.42	
Dahlonega †	67	10	41.8	3.69	T.
Diamond	63	8	38.3	......	......
Dublin	......	......	......	3.55	
Elberton †	70	17	44.6	2.82	
Fitzgerald	75	23	49.8	4.78	
Fleming †	74	26	50.2	3.40	
Fort Gaines	......	......	......	6.98	
Franklin	68	18	46.6	4.12	T.
Gainesville	66	14	42.1	3.37	
Gillsville †	......	......	......	3.54	
Greenbush	66a	14a	40.2a	2.78	T.
Griffin	67	15	44.2	4.40	
Harrison	72	26	47.4	2.06	0.5
Hawkinsville	......	......	......	1.85	
Hephzibah *6	74	30	49.3	2.58	
Jesup	77	23	50.8	3.69	
Lagrange †	71	16	46.0	4.53	T.
Louisville	75	25	48.0	1.87	
Marietta	69	14	42.7	1.78	T.
Marshallville †	75	23	48.1	4.19	
Mauzy	80	26	51.2	6.14	
Millen	69	26	48.2	3.06	
Morgan	75	13	47.1	6.52	
Mount Vernon	72	29	50.6	5.00	
Newnan	......	14		4.15	
Pelham	......	......	......	5.03	
Piscola	74	28	51.5	5.80	
Point Peter	65	14	41.7	3.62	
Poulan †	77	22	49.3	4.15	
Putnam	......	......	......	4.11	
Quitman †	75	25	50.2	4.72	
Ramsey	69	10	42.9	1.46	T.
Resaca	......	......	......	2.09	T.
Reynolds	......	......	......	3.32	
Rome †	70	17	41.8	1.80	T.
Talbotton †	67	20	46.2	4.23	T.
Tallapoosa	68	8	41.2	1.91	0.2
Thomasville †	76	26	50.0	5.05	
Toccoa †	66	15	42.0	2.79	
Washington †	......	......	......	2.88	
Idaho.					
American Falls	42	−12	17.0	0.00	
Atlanta	42	− 9	20.1	1.48	14.0
Blackfoot †	42	−14	15.0	0.05	0.5
Boise Barracks	46	2	25.3	0.98	4.8
Burnside †	41	− 5	16.2	0.30	3.0
Downey	40	−22	13.3	1.80	18.0
Fort Sherman †	47	5	25.9	2.06	12.2
Gimlet	44	− 9	18.2	0.69	6.9
Idaho City	50	−13	20.2	1.56	9.8
Lake	28	−12	8.2	1.50	15.0
Lakeview	53	10	28.4	2.03	7.5
Lewiston	54	5	30.0	0.45	0.0
Lost River	43	−17	14.5	0.08	0.8
Minidoka	46	−15	18.9		
Moscow	48	2	25.6	1.71	9.1
Murray †	47	− 6	21.8	3.57	29.0
Oakley	49	0	24.2	0.20	2.0
Ola	53	−12	20.5	1.56	12.8
Paris	43	−19	12.8	0.81	13.2
Payette	45	− 5	24.7	0.36	2.5
Pollock †	50	− 5	29.8	0.28	0.0
St. Maries	47	− 2	30.2	1.89	14.0
Soldier †	45	−29	12.1	0.35	3.5
Swan Valley †	44	−29	10.5	0.77	7.7
Warren	51	−20	22.1	1.44	......
Weston	45	−14	15.7	0.40	2.0
Yellow Jacket	......	......	......	0.90	......
Illinois.					
Albion †	60	− 3	31.2	1.47	3.0
Alexander †	59	− 5	28.3	1.19	3.5
Ashton	48	− 6	21.8	1.17	7.9
Astoria	54	− 1	26.6	0.97	4.0
Atwood a *5	54	− 6	24.7	2.30	1.0
Aurora a	48	− 3	23.2	1.66	......
Aurora b	47	− 2	23.2	1.99	7.0
Bloomington	53	1	26.4	1.92	4.0
Bushnell	57	0	26.1	0.55	2.5
Cambridge	54	− 6	23.7	0.60	2.5

TABLE II.—*Meteorological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Illinois—Cont'd.	°	°	°	*Ins.*	*Ins.*
Carlinville†	60	−7	29.4	2.16	5.6
Carlyle	......	......	......	1.80	2.0
Carrollton	54	−4	26.4	1.82	3.5
Charleston	56	−10	28.8	1.79	4.9
Chemung	48	−8	19.0	0.89	4.0
Chester	......	......	......	2.23	5.7
Cisne†	60	−3	31.4	1.64	2.5
Coatsburg	54	−5	25.0	1.53	7.0
Cobden†	62	−9	33.2	1.69	3.2
Cordova	49	−10	22.6	0.50	1.8
Danville	54	−2	28.4	1.86	2.5
Decatur†	57	−1	28.2	1.68	5.0
Dixon†	52	−6	22.0	0.78	2.5
Dwight†	46	−6	23.8	1.26	4.0
Effingham†	59	−7	30.4	1.84	3.5
Elgin	48	−5	21.6	1.25	3.3
Equality	64	3	35.0	1.83	2.5
Flora	60	−5	31.2	1.52	1.6
Fort Sheridan	44	−5	23.4	0.91	1.9
Friendgrove†	......	......	......	1.83	2.0
Galva†	54	−8	23.0	0.61	3.1
Glenwood*[1]	46	−5	25.8	1.79	8.0
Grafton†	......	......	......	1.34	3.0
Grayville	60[c]	3[c]	33.0[c]	1.60	3.0
Greenville†	57	−6	29.4	1.47	2.1
Griggsville†	59	−1	27.6	0.97	......
Halliday*[1]	60	−4	32.4	1.52	1.5
Havana†	58	1	30.0	1.45	2.5
Henry	51	−3	25.4	1.32	2.0
Hillsboro†	58	−7	28.9	2.00	3.0
Joliet†	46	0	24.6	2.15	8.4
Kankakee *a*	45	−1	28.1	1.17	4.0
Kishwaukee	......	−8	......	0.84	4.2
Knoxville	55	−6	23.0	0.83	1.6
Lagrange†	46	−1	24.0	1.56	3.2
Laharpe	56	−5	25.9	0.42	0.5
Lanark†	47	−9	19.4	0.34	2.5
Lexington	50	−1	24.9	1.18	6.0
Loami†	......	......	......	1.14	2.5
McLeansboro†	61	−3	32.0	1.69	2.0
Martinsville	58	−5	30.1	0.85	4.5
Martinton†	52	−4	25.2	1.80	2.0
Mascoutah	62	−10	29.6	1.48	3.2
Mattoon	54	−3	29.2	1.88	5.1
Minonk†	47	−2	24.0	1.04	7.0
Monmouth†	55	−7	24.7	0.47	1.0
Morrisonville†	55	−0	28.2	2.02	4.5
Mount Carmel†	......	......	......	2.21	7.5
Mount Pulaski	55	−1	27.4	1.50	5.5
Mount Vernon	55	−7	30.4	2.12	4.0
New Burnside†	64	0	34.2	2.24	3.0
Olney	60	−4	32.0	1.89	5.4
Oswego	46	−2	23.1	1.52	3.0
Ottawa†	46	−5	23.6	1.42	3.0
Palestine†	57	−8	29.6	2.33	3.8
Pana	54	−6	29.0	1.33	2.8
Paris	51	−1	27.4	1.37	......
Peoria *a*†	......	......	......	0.76	1.1
Peoria *b*†	52	−1	28.3	0.93	......
Philo†	55	−4	27.5	2.23	1.5
Plumhill†	61	−7	32.8	1.79	2.0
Rantoul†	55	−3	27.0	1.98	2.6
Raum	62	2	34.6	1.84	4.5
Reynolds	52	−7	23.0	0.50	1.5
Riley†	46	−7	20.4	0.76	2.5
Robinson	59	−4	31.2	1.74	......
Roundgrove†	53	−4[i]	20.6[c]	0.54	2.6
St. Charles*†[1]	45	−5	21.6	1.97	3.0
St. John	61	−4	31.8	......	......
Scales Mound	45	−12	16.8	0.41	2.8
Streator†	......	......	......	0.77	6.5
Sycamore†	46	−7	21.2	0.80	1.0
Tilden	59	−10	31.4	1.97	6.0
Tiskilwa†	46	−6	23.0	1.09	4.5
Tuscola†	57	−4	27.0	2.78	0.8
Walnut†	51	−5	24.6	0.96	2.6
Wheaton*[3]	......	−1	21.5	1.86	8.5
Winchester*[3]	58	0	27.6	1.79	1.0
Winnebago†	50	−8	20.5	0.71	3.0
Indiana.					
Anderson†	57	−4	28.2	2.04	9.8
Angola	50	−3	25.3	2.17	6.1
Auburn	53	−4	26.4	1.77	4.0
Bloomington	60	−5	30.8	2.90	8.0
Bluffton†	55	−3	27.8	2.12	7.6
Bright	59	−3	28.0	3.00	10.8
Butlerville†	58	−9	29.8	3.55	9.4
Cambridge City†	58	−26	27.2	3.01	13.7
Columbia City*[1]	60	−3	26.9	2.02	7.0
Columbus†	60	−16	29.4	2.51	9.8
Connersville†	58	−13	27.7	3.31	9.5
Crawfordsville	51	1	28.3	1.90	......
Delphi†	56	−2	26.5	1.96	3.5
Edwardsville*†[1]	61	3	33.2	3.71	6.4
Farmland	56	−1	28.7	2.47	13.2
Fort Wayne	55	−4	26.8	2.33	7.0
Indiana—Cont'd.					
Franklin*[1]	60	−12	29.3	2.22	9.9
Greensburg	58	−8	27.6	2.95	11.7
Hammond†	46	−3	23.3	1.38	3.3
Hector	45	−5	26.6	1.90	8.5
Huntington	55	0	28.0	2.11	5.5
Jeffersonville	60	8	33.4	2.69	1.1
Knightstown†	58	−17	28.0	3.57	17.0
Kokomo†	56	2	29.2	1.83	4.2
Lafayette†	54	−5	27.8	1.83	2.5
Laporte	47[c]	−3[c]	24.4[c]	2.29	......
Logansport *b*†	49	0	27.0	1.86	4.1
Madison	60	−1	32.0	3.01	4.2
Marengo†	66	−11	31.2	3.00	8.7
Marion†	56	−4	27.3	2.43	9.8
Markle	54	−1	28.2	2.50	9.0
Mauzy†	57	−12	27.7	3.36	16.0
Mount Vernon†	64	−2	32.4	1.21	2.5
Northfield†	56	−9	29.8	1.80	3.0
Paoli	59	−4	30.8	2.62	12.0
Peru	60	2	30.0	1.58	0.7
Princeton*[1]	56	−3	34.1	2.30	7.0
Richmond	57	−24	27.2	2.42	7.0
Rockville†	55	−7	28.6	1.32	3.0
Scottsburg	60	−6	31.9	3.10	8.0
Seymour	58	−4	29.8	3.27	10.0
Shelbyville	58	−8	28.8	2.22	12.2
South Bend†	54	−3	26.6	2.25	10.5
Syracuse†	......	......	......	2.20	8.8
Terre Haute†	57	0	30.4	1.42	2.9
Topeka†	49	−7	24.1	0.28	2.8
Valparaiso†	44	3	21.5	0.60	1.0
Vevay	60	0	33.4	2.85	6.0
Vincennes	61	1	32.3	1.27	3.0
Washington†	61	0	32.8	1.90	2.5
Winamac	53	−7	27.0	0.82	T.
Worthington†	58	−13	29.5	2.60	5.9
Indian Territory.					
Healdton†	76	1	37.2	4.03	9.0
Kemp	70[c]	4[c]	39.2[c]	2.40	4.0
Lehigh†	74	7	36.9	4.06	4.5
South McAlester†	......	......	......	2.16	4.0
Tahlequah	70	5	38.0	1.38	5.0
Tulsa†	......	......	......	3.81	......
Wagoner	......	......	......	1.88	4.0
Webbers Falls	......	......	......	1.25	T.
Iowa.					
Afton	42	−11	19.4	0.69	2.0
Albia	56	......	......	0.35	3.5
Algona*[1]	36	−23	14.5	0.37	3.8
Alta *a*†	46	−18	15.6	0.35	3.7
Amana†	42	−10	19.0	0.44	1.2
Ames *b*[1]	37[e]	−15	18.4	......	......
Ames (near)	......	......	......	0.30	1.1
Atlantic†	42	−12	17.9	0.58	2.0
Audubon	39	−15	18.0	1.10	11.0
Bedford	45	−12	20.4	0.72	2.0
Belleplaine	42	−12	18.7	0.28	1.8
Bonaparte†	53	−7	23.5	0.93	0.0
Britt	40	−13	14.0	0.41	4.1
Burlington[4]	58	−2	26.1	......	......
Carroll	42	−19	15.8	0.50	5.0
Cedarfalls	40	−16	17.4	0.20	2.0
Cedar Rapids†	44	−10	19.0	0.65	2.6
Chariton	49	−9	21.6	0.83	2.1
Charles City	44	−21	14.4	0.03	0.5
Clarinda†	......	......	......	0.90	4.5
Clear Lake	36	−21	14.4	0.20	2.0
Clinton	53	−8	21.8	0.42	1.2
College Springs	45	−10	21.1	0.86	3.0
Corning†	45	−10	24.0	0.60	2.0
Council Bluffs	49	−9	21.4	0.70	2.0
Cresco†	36	−20	12.2	0.38	1.7
Decorah†	37	−20	14.2	0.31	......
Delaware*[3]	41	−14	14.6	0.52	1.8
Denison	50	−18	17.4	0.14	2.0
Desoto[h]	44	−11	21.2	0.32	T.
Dows	37	−21	14.2	0.47	2.8
Eldon	......	−10	......	0.81	T.
Eldora	......	−20	......	1.70	7.0
Elkader†	45	−15	17.2	0.37	2.0
Estherville	35	−25	9.7	0.25	2.5
Fairfield†	51	−7	23.4	0.75	T.
Fayette†	40	−18	14.8	0.25	1.8
Fonda	36	−20	10.9	......	......
Forest City	39	−20	12.6	0.20	2.0
Fort Madison	......	......	......	1.47	T.
Galva	41	−18	17.2	0.26	......
Glenwood†	46	−10	22.4	0.30	3.0
Grand Meadow*[1]	40	−16	15.7	0.39	1.8
Greene	37	−19	15.3	0.33	0.8
Greenfield	44	−14	19.2	0.49	1.2
Grinnell	40	−12	18.8	0.01	0.1
Grundy Center	39	−17	15.6	0.40	1.5
Guthrie Center[h]	49	−14	13.4	0.25	1.5
Hampton	37	−18	15.0	0.46	3.0
Hawkeye	......	......	......	0.55	3.5
Iowa—Cont'd.	°	°	°	*Ins.*	*Ins.*
Hedrick*[1]	42[f]	−12[b]	16.7[d]	0.05	0.5
Hopeville†	43	−10	19.6	0.65	......
Humboldt†	39	−22	16.6	0.02	0.2
Independence†	40	−16	15.8	0.42	2.8
Indianola†	45	−12	20.6	1.01	2.5
Iowa City *a*	48	−10	20.8	0.53	0.3
Iowa Falls†	37	−18	14.7	0.40	4.0
Keosauqua	56	−5	24.6	1.09	1.0
Knoxville	49	−10	21.3	0.38	2.0
Lamoni[f]	38	−8	18.6	1.38	3.0
Lansing	44	−15	17.6	0.27	0.8
Larchwood	......	......	......	0.05	0.5
Larrabee†	43	−22	15.6	0.24	2.4
Leclaire	......	......	......	0.29	1.5
Lemars	43	−15	17.8	0.20	2.0
Lenox	42	−15	19.3	0.84	1.2
Logan†	39	−14	19.4	0.70	7.0
Maquoketa	52	−10	21.6	0.25	2.5
Mason City	45	−25	13.6	T.	T.
Monticello	45	−11	18.4	......	......
Mooar	58	−5	24.6	0.70	......
Mountayr	44	−10	19.6	1.01	3.0
Mount Pleasant	56	−7	26.5	0.37	......
Mount Vernon *a**[1]	46	−13	18.8	......	......
Mount Vernon *b*	44	−10	18.6	0.30	1.3
Neola	42	−8	18.8	......	......
New Hampton	39	−20	14.4	0.12	1.0
Newton†	42	−14	18.8	0.58	2.7
North McGregor	......	......	......	0.31	1.5
Northwood[4]	38	−20	16.0	......	......
Odebolt	38	−17	17.4	0.36	3.0
Ogden	39	−17	16.8	0.33	1.5
Olin	45	−10	19.2	0.16	1.5
Osage*[3]	......	−23	11.8	0.32	2.0
Osceola	46	−10	20.0	0.90	3.0
Oskaloosa†	48	−9	20.8	0.55	3.2
Ottumwa	50	−6	21.4	1.00	2.5
Ovid†	49	−11	21.6	0.98	4.0
Pella	......	−16	......	0.40	1.5
Plover	44	−21	17.0	0.22	2.2
Primghar	45	−20	17.3	0.10	......
Ridgway	43	−19	18.0	0.40	1.8
Rock Rapids	40	−22	12.8	......	......
Rockwell City	42	−20	16.6	0.15	3.0
Ruthven	39	−25	14.0	0.40	4.0
Sac City†	39	−19	16.2	0.40	4.0
Sibley	42[c]	−21[c]	14.0[c]	0.15	1.5
Sidney	44	−10	21.7	1.35	7.2
Sigourney	49	−12	20.2	0.59	0.5
Spencer	44	−23	13.4	0.32	......
Spirit Lake†	44	−24	15.4	0.32	3.2
Storm Lake	39	−19	16.4	0.28	3.2
Stuart	40	−13	17.8	0.15	1.5
Thurman	44	−11	20.8	1.07	6.1
Toledo	41	−14	17.4	0.50	1.0
Villisca	46	−14	18.0	0.70	3.0
Vintor[illegible]*[1]	40	−10	18.6	0.28	2.0
Wape[illegible]	......	......	......	0.53	T.
W[illegible]on	51	−11	20.3	0.38	T.
[illegible]	......	......	......	0.46	5.0
[illegible]	42	−15	16.8	0.33	1.0
[illegible]	38	−16	16.5	0.38	2.3
[illegible] City	37	−17	16.6	0.04	T.
[illegible]d*[1]	37	−22	13.8	0.40	4.0
W[illegible]aion	......	......	......	0.30	3.0
W[illegible]on*[1]	36[c]	−17[c]	15.5[c]	0.20	2.0
Wilton Junction†	49	−9	21.7	0.70	1.0
Winterset†	44	−10	20.6	0.71	T.
Kansas.					
Abilene†	55	1	26.2	2.13	2.5
Achilles	......	......	......	0.29	2.8
Altoona*[3]	56	−6	25.7	2.99	10.0
Anthony	......	......	......	2.65	6.0
Atchison†	56	−3	25.0	2.05	7.0
Augusta	61	−1	30.4	1.60	3.5
Beloit†	52	−3	25.0	1.36	3.0
Burlington†	59	−9	28.9	2.27	10.5
Campbell	51	−4	24.5	1.34	3.0
Chanute	61[e]	−6[e]	30.4[e]	3.28	13.0
Colby†	61	−21	26.2	0.42	3.5
Columbus	64	−9	30.0	3.28	15.0
Coolidge†	55	−10	26.4	0.75	T.
Cunningham†	60	−1	28.7	2.00	4.0
Delphos	60	−1	27.1	1.14	0.5
Ellinwood	60	−2	27.4	1.55	3.5
Emporia	60	2	30.2	2.60	11.0
Englewood†	65	−7	28.2	2.80	8.0
Eskridge	......	−3	......	2.14	9.0
Eureka	......	......	......	1.94	4.0
Eureka Ranch†	57	−10	26.8	0.55	T.
Fallriver	......	−2	......	1.52	......
Fanning	57	−8	25.8	1.34	11.5
Fort Riley†	58	−1	27.4	1.40	2.0
Fort Scott	66[e]	−10[d]	28.0[d]	3.39	12.0
Frankfort	55	−5	24.8	0.60	3.0
Garden City	55	−10	26.8	2.00	7.0

TABLE II.—*Meteorological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Kansas—Cont'd.	°	°	°	Ins.	Ins.
Gibson	58	−10	27.9	0.45	2.0
Gove *[1]	58	− 6	28.6	0.82	5.0
Grenola	64[e]	− 6	31.6	1.89	3.0
Halstead	......	......	......	2.28	4.0
Horton	49	− 2	24.8	1.65	5.0
Hoxie	......	......	......	0.57	5.8
Hutchinson	......	......	......	2.59	5.0
Independence	61	− 4	31.4	2.62	6.0
Lakin	55	......	......	1.70	5.0
Lawrence	58	− 2	27.4	1.56	8.0
Lebanon	50	− 5	25.8	0.70	6.0
Lebo †	59	− 5	27.8	3.62	7.5
McPherson	58	− 2	28.6	2.37	5.0
Manhattan *b*	58	1	26.3	1.33	3.5
Manhattan *c*	60	− 1	26.8	1.55	3.5
Marion †	66	− 3	29.0	1.80	4.0
Medicine Lodge †	65	− 1	30.0	2.00	5.0
Minneapolis †	57	0	25.6	1.40	3.0
Morantown †	59	− 5	28.1	2.57	8.8
Mounthope *[1]	58	2	29.7	2.03	4.0
Ness City [g]	56	− 2	27.5	1.34	2.0
Newton	60	0	29.6	2.20	5.0
Norwich	......	......	......	2.55	5.0
Oberlin	......	......	......	0.40	3.0
Olathe †	59	− 7	25.7	2.30	10.0
Osage City †	62	− 1	28.4	1.63	7.0
Osborne	......	......	......	1.12	....
Oswego	66	− 2	33.2	3.20	1.3
Ottawa	59	−10	27.3	1.97	9.0
Phillipsburg	......	− 4	......	0.53	5.0
Pittsburg	57	−10	28.3	1.30	......
Rome *†[1]	60	− 2	30.6	2.55	6.0
Russell	56	− 3	27.8	1.21	5.0
Salina †	56	1	26.8	1.67	4.0
Sedan †	63	− 5	31.8	2.49	5.5
Toronto	65	− 8	30.5	1.69	5.0
Ulysses	......	......	......	1.60	12.0
Viroqua †	64	− 7	26.6	2.60	21.0
Wallace	......	......	......	0.70	7.0
Wamego *[1]	56	0	25.6	1.45	1.5
Winfield	63	1	28.0	1.20	5.0
Yates Center	61	1	29.2	2.63	7.5
Kentucky.					
Alpha *[3]	......	− 3	36.3	2.74	9.0
Ashland	70	0	35.5	......	......
Bardstown †	65	− 2	35.2	2.74	4.0
Blandville †	60	− 1	34.1	2.25	3.5
Bowling Green *b* †	63	− 1	34.7	2.96	7.2
Burnside †	......	......	......	2.69	2.0
Caddo	63	− 7	31.3	4.57	11.0
Canton *[1]	62	0	36.2	2.96	9.0
Carrollton	60	− 2	32.3	1.99	1.5
Catlettsburg	......	......	......	2.83	1.0
Earlington	65	− 8	35.2	2.40	7.0
Edmonton †	63	− 8	35.4	2.87	6.0
Ensor	62	− 7	33.1	2.65	....
Eubank	65	−12	34.2	2.55	9.1
Falmouth †	......	......	......	3.09	3.3
Fords Ferry	64	− 5	34.2	1.89	4.0
Georgetown	63	− 8	33.8	......	......
Greensburg †	66	− 8	33.4	3.85	5.8
Henderson †	63	6	34.6	......	......
Hopkinsville †	64	− 8	36.2	3.51	8.5
Irvington	61	− 8	32.0	1.31	4.2
Leitchfield †	63	−10	32.8	2.94	6.2
Loretto	66	−10	32.6	2.55	5.0
Lyndon [j]	60	− 2	31.2	1.82	......
Maysville	66	− 5	33.6	3.27	3.6
Middlesboro †	68	− 5	35.1	3.62	4.4
Mount Hermon	63	− 2	34.4	2.29	4.3
Mount Sterling †	63	0	33.0	3.84	13.0
Owensboro †	63	− 1	34.3	2.49	3.2
Owenton †	63	− 1	32.0	2.84	6.5
Paducah *a* †	......	......	......	2.05	2.2
Paducah *b* †	64	5	36.8	1.76	2.2
Princeton	63	− 5	33.8	......	......
Richmond †	65	− 1	34.2	3.86	10.0
St. John †	62	− 9	33.2	2.76	3.0
Scott	60	− 3	30.6	2.85	11.3
Shelby City	64	− 8	33.2	3.74	7.5
Shelbyville †	63	− 3	32.6	2.87	9.9
Williamsburg †	66	1	36.4	2.53	0.1
Louisiana.					
Abbeville	76	25	49.6	2.72	
Alexandria †	77	20	47.6	2.96	1.0
Amite †	76	22	49.5	4.11	
Bastrop †	75	15	45.2	2.66	5.0
Baton Rouge †	78	24	49.3	4.13	
Calhoun	73	16	43.4	1.91	4.0
Cheneyville †	76	12	44.6	1.93	0.1
Clinton †	75	21	48.2	3.25	T.
Donaldsonville	78	24	49.8	5.65	
Emilie	73	23	47.8	3.66	
Farmerville	72	13	40.3	1.76	4.0
Franklin †	74	26	49.6	5.05	
Grand Coteau	74	24	49.2	2.72	
Louisiana—Cont'd.	°	°	°	Ins.	Ins.
Hammond	78	23	50.6	2.88	
Jeanerette	77	21	48.7	4.61	
Jennings	80	22	50.0	1.87	
Lafayette	74	23	48.4	3.13	
Lake Charles †	75	24	48.9	2.11	
Lake Providence	......	19	......	2.54	6.0
Lawrence	79	27	50.7	1.63	
Liberty Hill	76	17	45.5	1.71	4.5
Mansfield	75	13	45.1	2.80	3.0
Melville	74	21	48.7	3.05	
Monroe	74	18	45.2	2.16	3.0
Montgomery	......	......	......	1.56	1.0
New Iberia	73	25	48.5	3.65	
Oakridge	82	15	44.6	4.57	5.0
Opelousas	75	23	47.6	2.39	
Oxford	75	11	42.9	1.69	2.0
Paincourtville †	76	24	50.2	4.60	
Plain Dealing †	75	14	42.8	3.08	4.2
Plaquemine	73	23	49.2	3.18	T.
Rayne	74	22	49.0	3.14	
Robeline	75	12	43.7	2.65	2.0
Ruston	74	14	44.2	2.09	4.0
Schriever	79	24	50.6	4.31	
Shellbeach	68	28	50.4	2.38	
Southern University †	77	25	49.7	4.35	
Sugar Ex. Station	73	29	49.0	4.15	
Sugartown	72	24	48.2	2.95	
Wallace	79	25	50.7	4.66	
Maine.					
Bar Harbor	52	− 7	25.6	3.60	16.5
Belfast *[6]	41	−11	23.5	2.96	17.0
Calais	55	− 7	24.0	2.41	16.0
Cornish *[1]	49	−10	23.6	3.12	19.0
Cumberland Mills	50	−20	25.2	3.19	10.2
Fairfield	43	−30	21.4	1.42	12.5
Farmington	45	−21	19.7	1.44	9.9
Flagstaff	50	−25	18.0	1.05	10.5
Gardiner	45	−18	22.6	2.74	13.2
Lewiston	45	−19	22.2	2.85	14.8
Mayfield	43	−19	18.1	1.14	11.0
North Bridgton	48	−20	23.6	3.19	21.0
Orono	43	−14	20.7	1.27	7.0
Winslow	46	−28	21.9	1.59	8.2
Maryland.					
Bachmans Valley	60	4	31.4	6.02	2.5
Boettcherville	58	0	31.9	1.85	4.0
Charlotte Hall *	61	10	34.2	2.73	1.5
Cherryfields [2]	......	......	37.0	2.83	T.
Chestertown	62	16	35.6	5.98	3.0
Collegepark	61	4	36.0	4.41	3.8
Cumberland *b*	58	14	36.6	3.45	5.8
Darlington	60	9	33.1	4.03	4.0
Deerpark	58	−20	26.7	3.99	34.0
Easton	63	13	35.2	3.96	1.2
Ellicott City	66	6	33.6	5.32	3.2
Fallston	61	8	33.8	4.07	3.0
Frederick	60	3	34.0	3.46	4.5
Frostburg	64	5	31.7	2.75	......
Grantsville	60	− 4	26.8	2.73	22.5
Greatfalls	66	5	34.0	2.86	......
Greenspring Furnace	63	1	32.2	3.93	4.3
Hagerstown [f]	62	4	32.6	2.93	11.5
Hancock	61	4	31.9	1.89	4.2
Jewell †	68[e]	10[e]	35.0[e]	4.35	......
Johns Hopkins Hospital	67	12	33.8	3.95	......
Laurel	67	8	36.8	4.39	7.0
Mardela Springs	64	11	37.5	2.69	2.0
Mount St. Marys Coll.	59	7	32.6	3.04	5.0
New Market	60	10	33.2	3.39	3.5
Pocomoke City	70	16	44.6	2.77	......
Princess Anne	63	12	37.6	2.45	0.5
Sharpsburg	64	− 5	31.9	3.32	8.0
Smithsburg	62	4	32.5	4.75	8.0
Solomons †	65	17	37.9	3.29	1.0
Sudlersville [d]	67	15	38.5	3.21	3.0
Sunnyside	59	−17	26.5	4.31	26.0
Taneytown	58	2	31.1	3.36	6.5
Van Bibber	58	13	32.9	4.15	.. ..
Westernport	63	3	30.4	1.95	8.5
Woodstock	66	5	34.2	3.87	3.5
Massachusetts.					
Adams	52	− 9	28.5	......	......
Amherst	49	−12	27.2	2.23	8.5
Attleboro	......	......	......	2.07	.....
Bluehill (summit)	52	− 5	28.4	2.30	5.0
Cambridge *a*	55	− 6	29.8	2.53	......
Chestnut Hill	55	− 8	29.4	2.83	8.5
Cohasset	......	......	......	3.57	4.5
Concord	55	−14	26.8	2.77	8.8
Dudley [1] [e]	45[e]	− 5	27.5	......	.....
East Templeton *[1]	48	− 8	25.2	2.16	13.5
Fallriver	52	2	32.2	2.30	3.5
Fiskdale	......	......	......	2.99	17.0
Fitchburg *a* *[1]	51	− 3	27.1	2.85	11.0
Fitchburg *b*	54	− 9	26.9	2.97	10.2
Framingham	54	− 7	29.0	3.30	......
Massachusetts—Cont'd.	°	°	°	Ins.	Ins.
Groton	49	−12	25.2	2.57	16.0
Hyannis *†[1]	49	2	32.6	2.59	0.4
Jefferson	......	......	......	4.13	16.0
Lawrence	54	−14	27.4	2.58	5.2
Leeds	51	− 8	25.5	3.84	9.0
Leicester Hill	51	− 7	29.0	4.63	7.0
Leominster	......	......	......	3.02	9.0
Long Plain	......	......	......	2.24	......
Lowell *a*	52	− 8	27.0	2.74	......
Lowell *b*	54	−10	26.8	......	....
Ludlow Center	44	−10	22.6	3.25	15.5
Lynn *a*	51	− 3	28.8	2.86	......
Mansfield *[1]	52	−15	27.7	3.16	3.2
Middleboro	53	− 6	29.5	2.48	1.5
Monson	53	−16	27.0	3.06	8.5
New Bedford *a*	57	2	31.8	2.18	2.0
New Bedford *b*	52	0	31.7	2.41	2.8
New Salem	48	− 8	25.3	2.38	12.2
Pittsfield	50	− 8	25.0	2.19	8.5
Plymouth *[1]	53	− 4	31.6	2.76	......
Princeton	......	......	......	4.47	16.0
Salem	......	......	......	2.81	11.0
Somerset *[1]	52	− 6	31.8	1.99	3.0
South Clinton	......	......	......	3.75	14.5
Springfield Armory	51	4	28.1	3.05	10.0
Sterling	......	......	......	3.60	13.3
Taunton *b*	51	− 5	28.0	2.48	2.0
Taunton *c*	51	−13	28.4	2.63	......
Turners Falls	46	2	25.9	1.52	......
Webster	......	......	......	1.75	6.5
Westboro †	54	−10	29.1	2.24	4.5
Weston	54	− 9	27.8	3.10	9.2
Williamstown	53	−10	26.6	2.42	12.6
Winchendon	......	......	......	2.64	13.2
Worcester *a*	58	− 7	26.6	2.02	......
Worcester *b*	54	− 6	27.7	3.04	6.2
Michigan.					
Adrian	52	− 3	24.4	1.85	6.2
Agricultural College	44	3	24.8	1.42	8.8
Allegan	45	3	28.8	3.00	25.0
Alma	44	− 7	23.7	2.08	11.0
Ann Arbor	50	5[e]	25.3[e]	1.94	8.8
Arbela	41	− 1	25.4	2.47	7.0
Baldwin	46	−13	22.1	2.08	16.0
Ball Mountain	37	3	23.7	1.39	5.3
Battlecreek	50	3	25.8	2.25	9.0
Bay City	44	3	24.1	1.46	6.0
Berlin	45	− 6	23.2	2.34	10.7
Berrien Springs	51	− 3	26.0	3.55	21.5
Big Rapids	43	− 7	21.8	1.20	5.0
Birmingham	47	0	25.7	2.45	13.0
Boon	43	−10	18.8	2.58	25.9
Calumet	36	− 4	19.2	3.07	36.0
Camden [d]	40	− 1	24.4	1.30	......
Carsonville	47	0	25.2	1.89	7.0
Charlevoix	44	6	26.9	2.90	29.0
Cheboygan	43	0	22.1	1.52	11.5
Clinton	53	1	25.7	2.19	11.2
Coldwater	51	− 1	25.5	2.00	......
East Tawas	40	1	23.6	1.15	......
Eloise	50	− 2	25.8	2.90	6.0
Ewen	33	−23	15.8	......	......
Fairview	54	1	24.3	1.51	......
Fitchburg	51	0	24.4	1.74	8.2
Flint	50	− 1	24.8	1.28	1.0
Frankfort	41	10	26.2	......	......
Gladwin	45	−11	22.6	2.50	15.0
Grand Rapids	50	− 4	25.1	3.51	18.0
Grape	53	0	25.9	3.34	11.5
Grayling	44	−16	20.1	2.85	27.0
Hanover	52	1	24.0	1.66	7.0
Harrison	42	−11	21.5	1.17	8.8
Harrisville	43	− 6	22.6	1.77	17.7
Hart	42	5	25.8	2.45	18.5
Hastings	48	− 1	23.5	2.59	13.6
Hayes	40	0	26.2	0.32	......
Highland Station	......	......	......	2.30	10.0
Hillsdale	52	1	24.6	1.89	7.2
Holland *[9]	42	16	29.0	......	......
Howell	49	4	25.4	1.77	4.0
Humboldt	36	−35	11.6	1.08	......
Ionia	45	− 4	23.6	1.01	8.0
Iron River	37	−24	12.2	0.46	3.0
Ishpeming	36	−18	16.3	1.46	15.3
Ivan	45	2	22.3	3.62	32.5
Jackson	52	4	25.8	1.63	......
Jeddo	43	1	23.4	2.79	17.5
Kalamazoo	49	1	25.5	2.44	11.5
Lake City	41	− 6	20.0	1.65	16.5
Lansing	49	5	25.1	1.77	8.2
Lapeer	48	− 9	23.8	0.35	3.5
Lathrop	48	−12	15.3	0.60	6.0
Ludington	42	4	24.5	1.27	11.0
Luzerne	44	−10	18.2	2.13	13.5
Mackinaw City	40	0	23.2	1.08	10.0
Madison	49	− 4	25.1	2.20	9.5

TABLE II.—*Meteorological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Michigan—Cont'd.	°	°	°	*Ins.*	*Ins.*
Mancelona	44	−11	19.8	3.50	33.0
Manistee	43	3	24.3	1.26	12.0
Manistique	36	−5	18.0	1.07	11.1
Middle Island *[10]	40	6	25.9	......	......
Midland	46	2	25.1	......	......
Mottville	54	−7	24.1	2.09	7.5
Mount Clemens	48	−1	25.0	2.42	8.0
Mount Pleasant	45	−5	22.4	0.67	4.0
Muskegon	43	5	26.2	1.14	5.0
Newberry	35	−9	16.4	0.72	8.0
North Marshall	49	−3	23.6	2.24	4.0
Northport	46	9	26.4	3.30	33.0
Old Mission	45	8	25.6	2.35	23.5
Olivet	47	4	24.8	2.52	12.0
Omer	45	−12	21.6	1.15	6.5
Ovid	47	3	24.8	1.74	5.0
Parkville	......	......	......	2.44	8.0
Petoskey	43	4	24.3	2.17	23.0
Plymouth	49	−2	25.6	1.38	5.5
Port Austin	45	5	25.7	0.25	2.0
Powers	39	−15	14.8	0.35	3.5
Reed City	40	−12	19.0	1.00	7.0
Rockland	42	−15	15.6	2.40	24.0
Rogers City	46	−5	23.4	2.19	13.0
Romeo	40	2	24.7	3.05	12.0
Saginaw	48	4	25.8	2.11	8.0
St. Ignace	42	−3	23.2	0.50	5.0
St. Johns	46	5	26.4	0.90	5.0
St. Joseph	......	......	......	2.75	18.5
Sandbeach	47	0	26.1	0.67	2.5
Sidnaw	38	−23	16.4	0.68	7.1
Somerset	50	1	24.5	2.47	11.5
South Haven	52[b]	9[d]	26.9[c]	2.47	6.0
Stanton [f]	46	0	23.6	......	..
Thornville	46	1	25.7	1.56	11.5
Traverse City	48	−1	28.8	3.20	32.0
Vandalia	52	−4	25.6	2.68	11.8
Vassar	49	−5	25.1	1.23	1.6
Vermillion Point *[10]	32	0	17.0	......	...
Wasepi	52	−2	25.0	2.18	......
Waverly	47	−4	24.0	2.25	8.6
West Harrisville	44	−14	20.7	1.22	11.8
Wetmore	36	−24	16.2	1.67	21.0
White Cloud	44	−5	23.0	1.52	12.7
Williamston *	44	5	23.1	......	......
Ypsilanti	48	0	25.7	2.24	9.8
Minnesota.					
Ada†	40	−34	7.9	0.17	3.0
Albert Lea	36	......	......	0.12	1.3
Alexandria†	45	−25	10.6	0.09	0.9
Beardsley	43	−22	15.0	0.13	1.2
Bemidji	45	−34	13.4	0.52	5.0
Bird Island	47	−18	14.8	T.	T.
Blooming Prairie†	39	−25	11.7	0.05	0.5
Brainerd	40	−36	9.6	0.35	3.5
Caledonia†	35	−22	13.1	0.15	0.5
Collegeville	41	−22	17.2	0.10	0.9
Crookston†	40	−28	9.3	0.05	0.5
Deephaven	.. ..	......	......	0.12	1.2
Detroit City	41	−44	6.2	0.44	5.0
Farmington	......	......	......	T.	T.
Fergus Falls	43	−28	10.4	0.21	2.1
Glencoe	......	......	......	0.04	0.4
Grand Meadow†	37	−22	9.9	0.11	2.0
Koochicking	37	−39	5.7	0.20	......
Lake City	39	−25	12.3	0.04	1.0
Lake Jennie	40	−23	13.6	0.06	1.0
Lakeside†	42	−18	13.8	T.	T.
Lake Winnibigoshish	41	−45	5.4	0.20	4.2
Leech Lake	42	−51	5.2	0.44	4.4
Long Prairie	40	−34	10.8	0.13	1.8
Lutsen	45	−25	15.3	0.67	......
Luverne†	47	−16	14.6	0.02	0.2
Lynd	48	−19	17.7	0.08	1.2
Mapleplain	40	......	......	0.14	1.6
Milaca	42	−22	10.4	0.00	0.0
Milan†	52	−24	13.9	0.16	2.2
Minneapolis *a*	37	−25	10.4	0.07	0.7
Minneapolis *b*[1]	40*	−25	12.1	0.08	0.8
Minnesota City*[1]	40	−20	15.0	0.21	2.0
Montevideo	50	−21	14.6	T.	T.
Morris	48	−24	14.0	0.02	0.3
Mount Iron	48	−22	10.4	0.40	4.5
Newfolden	41	−35	4.8	0.34	2.0
New London	41	−24	12.0	T.	T.
New Richland*[1]	36	−28	10.9	......	......
New Ulm†	39	−18	13.1	T.	T.
Park Rapids†	43	−44	8.4	0.37	3.7
Pine River	39	−42	7.8	0.47	6.5
Pipestone	46	.. ..	......	T.	T.
Pleasant Mounds	43	−18	15.8	0.11	1.2
Pokegama Falls	40	−57	4.4	0.64	8.2
Redwing	......	......	......	0.00	
Reeds	......	......	......	0.15	0.1
Rolling Green	41	−18	14.0	0.60	6.0
Roseau	36	−36	4.9	0.32	5.3

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Minnesota—Cont'd.	°	°	°	*Ins.*	*Ins.*
St. Charles†	43	−22	13.6	0.35	1.5
St. Cloud	38	−28	11.4	0.00	0.0
St. Olaf	44	−24	10.8	0.27	3.0
St. Peter	38	−16	15.7	0.12	1.2
Sandy Lake Dam	40	−45	7.8	0.38	4.6
Shakopee	37	−18	14.0	0.05	0.5
Slayton	51	−17	17.6	T.	T.
Tower†	36	−46	6.7	0.60	6.0
Two Harbors	54	−29	14.9	0.25	2.2
Wabasha*[1]	37	−22	12.5	0.60	6.0
Willmar	46	−18	12.8	T.	T.
Willow River	44	−43	8.6	0.30	3.0
Winnebago City	......	......	......	T.	T.
Worthington [d]	30	−17	14.6	0.09	1.0
Zumbrota [1 g]	38*	−26	13.5	......	......
Mississippi.					
Aberdeen	70	14	40.9	2.30	T.
Agricultural College	73	12	43.2	2.20	T.
Austin†	70	9	41.0	3.75	4.0
Batesville†	61	10	37.4	2.10	4.0
Bay St. Louis	73	25	48.8	4.51	
Biloxi†	74	24	49.6	5.78	
Booneville	65	10	38.7	3.11	......
Brookhaven	75	18	46.2	2.52	
Canton†	73	15	44.0	3.46	T.
Columbus *a*	......	......	......	2.10	
Crystal Springs†	74	18	45.8	2.95	......
Edwards	74	19	45.2	2.83	2.0
Fayette	75	20	46.8	3.88	1.0
French Camps	......	......	......	3.45	2.5
Greenville *a*	69	18	41.8	1.66	2.5
Greenville *b*†	73	19	44.0	1.51	2.8
Greenwood	71	19	44.4	1.93	3.0
Hattiesburg†	71	21	46.3	2.95	
Holly Springs†	61[e]	11[e]	36.4[e]	2.07	5.0
Jackson	73	18	42.9	2.07	1.0
Kosciusko	65	12	40.8	3.57	4.2
Lake†	70	15	42.4	3.05	T.
Logtown†	72	26	49.4	3.66	
Louisville†	66	10	41.2	1.88	6.0
Macon	73	14	43.5	2.01	1.0
Magnolia†	74	20	46.3	4.56	
Meridian	73	15	44.8	2.50	
Natchez†	78	21	47.1	......	......
Okolona†	72	9	41.2	1.37	.. ..
Palo Alto	75	11	43.1	2.07	1.2
Pontotoc	70	10	41.2	3.18	2.0
Port Gibson†	75	20	46.2	2.49	3.8
Ripley [e]	68	7	35.6	3.42	5.5
Stonington*[1]	74	20	45.3	......	......
Thornton	......	......	......	2.12	3.5
Tupelo†	......	......	......	2.21	2.0
Walnut Grove	73[e]	18[e]	45.7[e]	3.42	2.0
Water Valley*†[1]	69	10	40.0	2.53	3.0
Waynesboro	78	20	46.6	5.71	
Woodville†	72	23	47.4	3.22	
Yazoo City†	75	12	42.7	2.08	2.0
Missouri.					
Appleton City	63	−11	30.6	1.49	3.5
Arthur*[3]	......	−17	26.6	2.77	8.0
Avalon	54	−8	25.6	1.68	3.0
Bethany	51	−12	23.0	1.33	6.5
Birchtree	64	−14	29.6	1.59	4.0
Boonville†	......	......	......	1.89	......
Brunswick	58	−3	24.8	0.85	4.5
Carrollton†	56	0	28.2	1.52	3.0
Conception	48	−8	24.8	1.58	10.5
Cowgill*[5]	58	−8	24.4	2.03	4.0
Darksville	55	−3	25.2	1.10	5.0
Downing	......	......	......	0.50	1.0
East Lynne*[3]	......	−7	26.8	2.47	7.5
Edgehill*[5]	54	−10	29.6	1.15	3.0
Eightmile*[1]	58	−6	26.3	1.98	7.0
Eldon	66	−20	29.6	1.16	5.3
Elmira	58	−13	24.7	1.70	7.0
Fairport	......	......	......	1.74	6.5
Farmersville	......	......	......	1.95	7.0
Fayette	63	−10	26.4	1.37	5.5
Fulton	......	......	......	2.73	7.0
Galena	......	......	......	2.02	5.0
Gallatin*[1]	52	−5	24.6	2.50	10.5
Gayoso	60	8	37.6	2.23	2.5
Glasgow	62	−4	27.3	1.42	7.0
Gordonville*[3]	......	−2	30.0	2.20	3.2
Gorin	......	......	......	1.89	5.0
Halfway	68	−14	31.8	1.35	4.0
Harrisonville†	60	−16	26.0	2.01	6.8
Hermann†	......	......	......	1.52	0.4
Houston	66	0	33.4	0.64	2.0
Houstonia	......	......	......	1.88	6.8
Irena	......	......	......	1.13	3.0
Ironton†	57	−15	31.0	1.36	2.0
Jefferson City†	64	−11	29.4	1.63	4.2
Kidder	54	−8	23.0	2.64	10.7
Lamar†	64	−9	32.0	2.09	4.9
Lamonte	......	......	......	1.99	7.7

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Missouri—Cont'd.	°	°	°	*Ins.*	*Ins.*
Lebanon	64	1	32.2	3.55	0.5
Lexington	58	−3	27.5	1.65	4.0
Liberty	59	−5	25.4	1.31	9.0
Louisiana	62	−11	28.0	1.58	4.5
McCune*†[1]	62	−5	27.9	1.38	8.2
Marblehill	64	−7	32.6	2.53	2.0
Marshall†	59	−11	26.1	2.17	6.0
Maryville	48	−8	20.3	1.26	3.0
Mexico†	63	−9	27.8	1.82	4.2
Miami	......	......	......	1.91	2.2
Mineralspring	65	−3	32.8	2.37	5.5
Montreal	63	−14	30.8	1.52	6.0
Mount Vernon	69	−10	35.1	1.90	7.5
Neosho	68	−12	33.7	1.78	8.5
New Haven	65	−10	30.2	1.56	4.0
New Madrid	72	−3	39.9	2.61	2.5
New Palestine	......	......	......	2.36	7.0
Oakfield	64	−5	32.5	0.79	4.0
Olden†	63	2	33.6	1.40	3.5
Oregon *a*	50	−4	23.8	2.06	9.1
Oregon *b*	55	−4	25.6	1.94	9.5
Palmyra*[5]	58	−4	26.3	2.00	13.0
Phillipsburg*†[1]	63	1	29.8	1.29	3.9
Pickering*[3]	......	−16	19.2	1.61	3.0
Poplarbluff	63[e]	−1[e]	36.4[e]	1.65	3.0
Potosi	60	−15	29.6	1.05	3.0
Princeton	50	−6	23.1	1.90	7.0
Rhineland	66	−17	30.8	1.67	4.0
Richmond	55	−4	24.9	1.80	4.3
Rolla	......	......	......	1.10	3.1
St. Charles	61	−6	30.0	1.16	6.0
St. Joseph	......	......	......	1.47	4.0
Sarcoxie*[3]	......	0	25.6	1.81	7.0
Sedalia	......	−10	......	1.34	6.5
Seymour	63	−1	32.5	1.50	2.0
Shelbina	......	......	......	1.20	2.5
Sikeston	62	0	33.8	1.97	1.8
Steffenville	56	−4	26.5	1.80	9.0
Stellada†	61	−15	27.6	0.86	5.0
Sublett	53	−8	22.2	2.70	6.0
Vichy	71	−9	30.8	0.66	4.5
Warrensburg	62	−5	27.2[f]	1.92	6.4
Warrenton	62	−8	27.0	1.78	6.0
Wheatland	......	......	......	2.05	3.0
Willow Springs	63	−16	31.3	1.64	3.5
Zeitonia	64	−4	32.4	1.32	2.2
Montana.					
Adel	50	−29	22.3	1.05	10.5
Billings	60[h]	−14[h]	23.4[h]	0.10	1.0
Boulder	50[e]	−15[e]	17.6[e]	0.05	0.5
Castle	49	−13	22.6	0.36	3.6
Corvallis	59	−11	24.9	0.02	0.2
Crow Agency	61	−15	20.6	0.24	6.0
Darby	40	2	22.4	T.	T.
Dearborn Canyon	50	−30	23.6	0.80	8.0
Deer Lodge	51	−14	17.8	......	......
Dell	41	0	16.6	0.20	2.0
Ekalaka	49	−16	19.8	0.47	4.7
Florence	52	−8	21.3	0.41	......
Fort Benton	56	−18	24.6	0.40	4.0
Fort Keogh	60	−15	17.6	0.40	4.0
Fort Logan	49	−24	12.8	0.56	......
Glasgow	46	−16	11.4	0.07	......
Glendive†	50	−8	18.2	0.40	4.0
Glenwood	43	−14	18.0	0.80	......
Greatfalls†	56	−15	27.4	0.37	10.5
Kalispel	55	−5	22.0	0.33	3.3
Kipp†	53	−37	23.2	0.66	6.6
Livingston†	50	−9	23.8	0.10	1.0
Manhattan†	51	−21	15.0	0.11	1.0
Martinsdale†	50	−17	22.7	0.07	0.5
Marysville†	47	−15	21.0	1.89	12.0
Missoula	54	−6	21.4	0.33	3.0
Plains	48	−4	24.5	0.10	1.0
Poplar	45	−16	11.8	0.60	6.0
Radersburg	......	......	......	0.10	1.0
Redlodge	50	−17	20.7	0.97	9.7
St. Ignatius Mission	55	−6	23.8	0.23	2.6
St. Pauls†	53	−19	25.5	0.33	3.3
Shelby	52	−29	24.3	0.30	3.0
Troy	50	−8	23.4	1.35	6.0
Utica	64	−23	27.0	0.59	8.2
Wibaux [1]	44	−18	12.7	0.30	3.0
Yale	......	−16	......	0.40	4.0
Nebraska.					
Agee*[1]	62	−10	21.8	0.35	3.0
Albion	61	−17	23.4	0.20	2.0
Alliance	......	......	......	0.00	
Alma*[1]	67	−10	27.8	0.04	0.9
Ansley†	63	−17	24.8	0.20	2.0
Arapaho*[1]	62	−11	25.9	0.08	0.8
Arborville*[1]	56	−12	22.7	0.33	3.0
Ashland *a*†	49	−10	22.0	0.16	......
Ashland *b**[1]	43	−11	21.0	0.42	2.7
Ashton	......	......	......	0.09	2.0
Auburn*†[1]	50	−10	22.8	1.72	6.5

TABLE II.—*Meteorological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.		Stations.	Temperature. (Fahrenheit.)			Precipitation.		Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.		Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.		Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Nebraska—Cont'd.	°	°	°	*Ins.*	*Ins.*	*Nebraska*—Cont'd.	°	°	°	*Ins.*	*Ins.*	*New Jersey*—Cont'd.	°	°	°	*Ins.*	*Ins.*
Aurora	....	....	....	0.32	0.8	Seneca *[1]	60	−14	23.6	0.15	1.5	Beverly †	65	6	33.8	3.41	0.5
Bartley	....	....	....	0.14	T.	Seward *[1]	50	− 8	22.5	0.72	2.2	Billingsport *[1]	58	12	32.7	2.99	....
Bassett	....	....	....	0.25	2.5	Spragg	....	....	....	0.30	3.0	Boonton	55	5	30.4	3.66	1.5
Beatrice †	44	− 7	21.6	0.74	....	Springview	55	−15	21.0	1.00	10.0	Bridgeton	65	14	36.1	4.85	0.2
Beaver City †	65	−14	28.5	0.06	T.	Stanton	....	....	....	0.44	6.0	Camden	59	14	33.8	3.47	0.3
Bellevue	....	....	....	0.30	3.3	State Farm	50	− 9	24.2	....	....	Cape May C. H.	61	11	37.5	2.67	T.
Benedict	....	....	....	0.49	4.6	Strang *[1]	48	− 9	25.3	0.92	6.0	Charlotteburg	59	2	30.1	4.27	5.0
Blair	47	−14	21.6	0.20	1.7	Stratton	....	....	....	0.18	1.3	Chester	55	4	30.1	2.58	9.0
Bluehill	....	....	....	0.39	4.0	Superior *[5]	48	− 6	24.5	0.60	6.0	Clayton	64	9	34.3	4.21	0.5
Bradshaw	....	....	....	0.25	1.5	Tablerock	....	....	....	1.66	4.0	College Farm	60	6	32.6	3.16	1.5
Brokenbow	....	....	....	T.	T.	Tecumseh *b* †	50	− 9	26.4	....	....	Deckertown	56	1	29.5	2.38	1.5
Burchard	....	....	....	0.43	4.0	Tecumseh *c*	....	....	....	1.15	3.0	Dover	54	6	29.6	2.67	1.5
Burwell	....	....	....	0.65	6.5	Tekamah	50	−14	20.5	0.60	6.0	Egg Harbor City	64	4	34.2	4.41	T.
Callaway †	62	−14	24.7	T.	T.	Thedford *[1]	60	−20	22.3	0.15	1.5	Elizabeth	60	7	32.6	3.63	....
Camp Clarke	61	−22	22.6	0.35	3.5	Turlington †	48	− 9	21.5	1.06	4.5	Englewood	58	0	30.0	4.07	8.3
Central City *[5]	48	−14	22.8	0.25	2.5	Valentine †	61	−16	23.2	0.37	3.7	Flemington	59	4	31.4	3.29	T.
Chester	....	....	....	1.67	T.	Wakefield	52	−15	20.8	0.20	2.0	Freehold	64	7	33.8	3.77	T.
Clatonia	....	....	....	0.70	1.0	Wallace	....	....	....	0.02	0.2	Friesburg	64[f]	12[f]	34.8[f]	3.65	0.5
Cody	....	....	....	0.10	1.0	Wauneta	....	....	....	0.05	0.5	Gillette	58	10	31.2	3.63	2.0
Columbus †	60	−15	24.4	0.11	0.5	Weeping Water *[1]	46	−15	18.9	1.04	8.0	Hammonton	....	....	....	3.45	1.0
Creighton †	58	−15	20.8	0.35	2.0	Westpoint †	52	−17	21.2	0.04	0.5	Hanover	53	7	31.7	3.64	T.
Crete	49	− 8	23.4	0.60	4.5	Whitman	....	....	....	0.10	1.0	Hightstown	61	9	33.2	4.23	0.5
Culbertson	....	....	....	0.07	0.2	Wilber *[1]	52	− 2	25.3	0.87	....	Imlaystown	64	8	34.5	3.38	0.4
Curtis *a*	64	− 7	29.6	0.16	....	Willard	....	....	....	0.01	0.1	Lambertville	57	10	32.8	3.07	T.
David City	53	−12	11.8	0.40	3.5	Wilsonville *[1]	62	−19	25.5	0.00		Lebanon	....	....	....	4.20	5.5
Dawson	52	− 7	24.8	1.27	....	Wymore *[1]	54	− 6	22.8	0.98	T.	Moorestown	64	10	34.5	4.00	1.2
Dunning	....	....	....	....	....	York *[1]	52	−10	23.8	0.80	8.0	Mount Pleasant	....	....	....	3.70	0.8
Eden	....	....	....	1.70	4.0	*Nevada.*						Newark *b*	58	10	32.4	3.52	3.0
Edgar *[1]	52[i]	10[i]	27.9[i]	0.58[c]	1.5	Austin	49	3	26.6	1.14	5.5	New Brunswick *a*	58	7	32.7	3.57	0.5
Elba	....	....	....	0.05	0.5	Battle Mountain *[1]	44	2	24.3	0.27	0.2	Ocean City	55	11	36.2	3.32	....
Ericson *†[1]	44	−18	18.8	0.20	2.0	Beowawe *[1]	51	0	23.2	0.42	2.0	Oceanic	66	7	32.8	3.38	3.5
Ewing †	....	....	....	0.05	0.5	Blaine	....	− 8	....	1.15	8.0	Paterson	60	9	33.7	4.01	7.8
Fairbury †	51	− 5	24.0	0.90	T.	Bunkerville	....	....	....	T.	T.	Perth Amboy	59	10	33.1	3.32	1.0
Fairfield	....	....	....	0.30	1.0	Carlin *[1]	40	− 1	16.5	....	....	Rancocas	....	....	....	3.80	2.5
Fairmont †	53	−10	24.7	0.60	2.0	Carson City	58	3	30.4	0.13	0.1	Rivervale	58	− 2	30.0	3.79	8.0
Fort Robinson	59	−20	22.6	0.51	5.1	Clover Valley	....	....	....	0.99	6.8	Roseland	57	2	30.4	3.79	1.0
Fremont †	48	−14	21.0	0.70	4.0	Cranes Ranch	....	....	....	0.67	0.7	Salem	63	14	35.8	4.44	0.5
Geneva †	50	− 8	23.6	0.75	5.0	Darrough Ranch	....	....	....	0.58	2.0	Somerville	60	3	32.4	3.52	0.4
Genoa	59	−15	23.7	0.15	1.6	Elko *[1]	40	0	22.0	0.60	4.0	South Orange	56	7	31.6	3.39	2.0
Gordon	....	....	....	0.10	....	Elko (near)	51	−15	19.0	0.99	11.0	Staffordville	....	....	....	3.75	T.
Gothenburg	61	− 8	25.0	0.11	1.0	Ely	67	− 8	23.8	1.05	3.0	Toms River	66	0	33.6	4.10	0.5
Grand Island *a*	....	....	....	0.52	1.0	Fenelon *[1]	39	− 5	17.8	0.90	9.0	Trenton	60	14	35.3	3.86	2.0
Greeley	....	....	....	T.	T.	Golconda *[1]	50	3	24.3	0.19	1.0	Vineland	65	7	35.2	3.37	0.5
Haigler	....	....	....	T.	T.	Halleck *[1]	41	−12	13.0	0.32	3.6	Woodbine	63	16	37.0	3.37	2.0
Hartington †	57	−13	21.4	0.25	2.5	Hawthorne *a* *[1]	63	13	31.0	0.06	T.	*New Mexico.*					
Harvard	55	−11	25.6	0.38	3.8	Hawthorne *b*	65	8	31.8	0.26	0.8	Albert	54	4	28.4	2.18	6.0
Hastings *[1]	57	− 8	24.7	0.24	2.5	Hot Springs	....	....	....	T.	T.	Albuquerque †	59	3	29.1	0.70	7.0
Hayes Center	....	....	....	T.	T.	Humboldt *[1]	50	5	27.7	0.40	4.0	Alma	62	− 5	31.5	1.51	19.5
Hay Springs	57	−22	21.4	0.62	5.8	Lewers Ranch	58	5	30.8	2.40	0.6	Aztec †	55	−16	17.1	1.44	14.4
Hebron †	47	− 6	23.8	0.94	2.7	Los Vegas	63[h]	12[h]	35.8[h]	0.20	2.0	Bernalillo †	54	3	29.5	0.75	7.5
Hickman	....	....	....	0.08	4.0	Lovelocks *[1]	46	5	25.1	....	....	Bluewater	54	− 2	24.5	0.40	4.0
Holdrege *b*	....	....	....	T.	T.	McGill [f]	51	− 2	22.4	0.04	0.0	Buckmans	48	−30	14.2	1.22	15.0
Hooper *[1]	52	−15	19.0	0.23	2.5	Martins	60	4	29.6	0.50	0.0	Clayton	66	− 2	30.4	0.85	8.5
Imperial †	67	−15	26.6	0.92	4.5	Mill City *[1]	58	4	26.1	0.60	2.0	Deming *[1]	72	10	37.0	0.60	6.0
Johnstown	....	....	....	0.12	1.0	Monitor Mill	49	− 6	22.0	0.47	1.5	East Lasvegas †	58	− 2	28.1	0.80	8.0
Kearney	....	....	....	0.10	1.0	Palisade *[1]	58	2	23.0	0.41	4.5	Eddy	75	10	37.0	1.70	6.0
Kennedy	60	−18	23.3	0.40	4.0	Palmetto	64	− 6	27.6	0.30	3.0	Engle †	62	4	28.6	1.50	15.0
Kimball †	55	−16	23.1	0.55	5.5	Panaca	70	− 2	29.4	T.	0.0	Espanola	50	−14	22.8	0.60	6.0
Kirkwood *[1]	63	−14	21.2	0.24	2.5	Reno *[1]	66	6	31.9	T.	T.	Folsom	55	− 8	24.2	2.62	28.4
Lexington †	66	−13	26.7	0.35	2.0	Reno State University	55	7	29.1	....	....	Fort Bayard	63	10	35.5	0.70	7.0
Lincoln *b*	49	− 6	24.0	....	....	St. Clair	59	0	25.8	0.21	0.5	Fort Union	62	− 2	27.4	1.50	11.0
Lincoln *d*	50	− 3	24.9	0.53	3.3	Silverpeak	57	2	30.1	0.03	0.5	Fort Wingate	59	0	22.0	1.44	8.0
Lodgepole †	59	−22	23.2	0.50	5.0	Sodaville	68	3	31.2	0.16	T.	Galisteo	53	1	28.7	0.50	5.0
Loup *b* *[1]	60	−18	21.8	T.	T.	South Fork	....	....	....	0.84	8.5	Gallinas Spring †	60	1	29.4	1.13	4.0
Lynch *†[1]	62	−15	20.0	0.07	0.8	Tecoma *[1]	35	− 5	14.5	0.55	6.0	Gila	63	0	36.1	1.52	8.0
Lyons	....	....	....	0.92	7.5	Toano *[1]	48	− 8	17.7	0.64	7.0	Hillsboro	....	19	....	0.80	8.0
McCook	....	....	....	0.15	1.5	Tuscarora	39	− 6	19.8	0.20	2.0	Laluz	54	14	32.8	....	....
McCool	....	....	....	0.55	2.0	Tybo	50	− 2	23.4	0.24	4.0	Las Vegas Hotsprings	57	0	27.7	1.88	9.5
Madison	58	−13	21.4	0.16	3.0	Verdi *[1]	56	10	38.7	0.36	0.7	Lordsburg *[1]	71	8	32.8	0.66	2.5
Madrid *[5]	55	−15	24.4	0.20	2.0	Wadsworth *[1]	60	− 4	23.8	0.09	0.5	Los Lunas	50	− 4	26.3	0.87	5.0
Marquette	....	....	....	0.32	3.0	Wells	46	−13	18.4	0.62	6.6	Lower Penasco	66	3	34.6	2.40	15.1
Merriman	....	....	....	0.10	1.0	*New Hampshire.*						Mesilla Park	68	10	35.5	1.25	5.1
Minden *a*	61	−12	25.8	0.30	2.9	Alstead *[6]	41	−14	22.7	2.96	7.5	Monero	45	−20	16.6	0.76	10.0
Monroe	....	....	....	0.13	....	Berlin Mills	54	−30	20.3	1.86	7.5	Puerto de Luna	65	4	33.6	1.95	12.5
Nemaha *[1]	48	−10	20.8	1.15	3.0	Bethlehem	51	−18	21.2	2.23	16.5	Raton	60	− 8	25.6	0.20	2.0
Nesbit	59	−17	23.8	0.13	1.0	Brookline *[1]	52	−23	24.6	3.55	11.0	Rincon †	65	10	34.9	0.73	5.0
Norfolk *b*	58	−12	20.2	0.42	5.5	Concord	48	−19	23.3	2.26	11.8	Roswell †	73	7	33.0	1.37	9.5
North Loup	60	−17	24.2	0.30	3.0	Durham	47	− 6	25.4	2.47	6.0	San Marcial	68	2	32.6	1.13	11.0
Oakdale †	56	−13	20.6	0.44	5.5	Grafton	49	−27	19.6	1.93	9.0	Shattucks Ranch	60	− 2	33.2	2.27	21.5
Odell	....	....	....	0.70	....	Hanover	45	−23	21.9	1.40	5.5	Socorro	59	4	29.2	0.55	4.0
O'Neill	63	−17	22.0	0.05	0.5	Keene	48	−22	23.8	2.45	11.2	White Oaks †	55	0	28.5	0.90	9.0
Osceola	....	....	....	0.02	0.2	Littleton	46	−18	19.5	1.75	14.2	Winsors Ranch	53	−13	21.6	2.25	....
Ough †	....	....	....	T.	T.	Nashua	52	−15	25.2	3.05	12.2	*New York.*					
Palmyra	....	....	....	0.70	1.5	Newton	53	−12	26.0	2.84	7.0	Adams	....	....	....	4.04	....
Plattsmouth *b*	....	....	....	0.50	5.0	North Conway	54	−18	23.1	3.05	18.0	Addison	54	− 4	28.0	2.15	9.5
Pleasant Hill	....	....	....	0.82	8.2	Peterboro	48	−21	22.8	3.82	13.3	Akron	....	....	....	2.31	....
Ravenna *a*	62	−15	25.8	0.37	2.5	Plymouth	42	−12	21.2	1.72	6.3	Alfred	52	0	27.2	2.80	27.0
Redcloud *a*	....	....	....	0.53	T.	Sanbornton	48	−19	22.6	2.97	17.0	Angelica †	52	3	27.3	2.58	23.0
Redcloud *b* *[1]	40	0	20.9	0.73	1.3	Stratford	47	−22	21.2	1.37	16.0	Appleton	50	8	28.4	2.26	18.5
Republican *[1]	60	−10	19.5	0.05	0.5	Warner	....	....	....	2.39	11.5	Arcade	50	1	24.4	3.15	25.8
Rulo	....	....	....	1.04	0.4	*New Jersey.*						Atlanta	....	....	....	2.91	....
St. Libory	....	....	....	0.40	4.0	Asbury Park	65	7	34.8	3.13	1.0	Auburn	55	0	28.7	2.50	7.0
St. Paul	....	....	....	0.12	1.0	Barnegat	54	20	36.4	3.54	0.5	Avon	56	0	26.0	1.83	....
Salem *[1]	48	− 4	22.5	1.79	4.5	Bayonne	61	11	33.3	2.88	1.8	Baldwinsville	54	5	27.6	3.13	22.0
Santee Agency †	61	−14	23.0	0.27	4.5	Belvidere	55	2	29.1	3.25	7.0	Bedford	58	− 1	30.4	2.91	3.8
Schuyler	....	....	....	0.20	2.0	Bergen Point	59	13	33.7	3.52	4.5	Bolivar	58	− 3	26.8	2.04	14.5

TABLE II.—*Meteorological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
New York—Cont'd.	°	°	°	*Ins.*	*Ins.*
Bouckville	50	−7	23.2	3.25	22.0
Boyds Corners	.....	.....	.....	3.17	.....
Brentwood	57	1	32.2	3.25	.....
Canajoharie	55	−16	27.6	1.42	.....
Canton	48	−15	22.9	2.52	15.2
Carmel	53	2	29.0	3.31	7.5
Carvers Falls	46	−15	24.9	1.59	3.0
Catskill	51	−2	29.6	2.24	10.0
Cedarhill	54	−6	28.9	0.91	4.2
Cherry Creek	.....	.....	.....	4.03	.....
Cherry Valley	.....	.....	.....	3.08	.....
Cooperstown †	51	−7	25.2	2.44	14.5
Cortland	53	−2	26.6	2.61	18.5
Dekalb Junction	.....	.....	.....	2.13	.....
Dryden	54	−2	26.6	3.02	.....
Easton	.....	.....	.....	1.24	.....
Ellenburg Depot *[1]	50	−10	23.7	2.51	19.5
Elmira	58	0	30.2	2.25	.....
Fayetteville	.....	.....	.....	2.15	.....
Fleming	53	3	28.4	1.80	18.0
Fort Niagara	51	7	29.4	1.47	14.0
Franklinville	52	−4	24.9	2.64	20.2
Fulton	.....	.....	.....	1.33	.....
Gloversville *[1]	41	−10	23.9	2.62	14.3
Greenwich	50	−17	25.2	1.83	4.0
Haskinsville	.....	.....	.....	1.37	.....
Hemlock Lake	53	5	28.7	2.24	.....
Honeymead Brook	54	−7	27.8	2.14	4.5
Humphrey †	51	5	25.3	2.82	32.4
Ithaca	52	3	27.8	2.22	13.8
Jamestown	50	7	27.2	4.84	38.0
Keene Valley	51	−12	22.5	1.75	9.1
Kings Station	.....	.....	.....	5.67	.....
Lake Placid	47	−18	20.6	2.70	.....
Liberty	55	−1	25.1	.....	.....
Little Falls	.....	.....	.....	2.57	25.0
Lockport	48	9	28.0	1.70	17.0
Lowville	48	−24	23.0	4.54	50.0
Lyndonville	.....	.....	.....	1.83	.....
Lyons	55	8	29.6	1.94	15.5
Madison Barracks	54	−28	28.0	2.40	24.0
Middletown	52	2	29.0	3.82	10.0
Mohonk Lake[1]	51*	3	28.7	.....	.....
Mount Morris	.....	.....	.....	1.60	15.5
Newark Valley	.....	.....	.....	2.37	.....
New Lisbon	53	−14	23.7	1.48	8.5
Niagara Falls	.....	.....	.....	3.08	.....
North Hammond †	50	−8	25.6	1.37	16.6
North Lake	.....	−28	.....	6.19	52.5
Number Four †	46	−22	21.8	7.44	70.6
Nunda	51	−1	27.4	2.33	19.0
Ogdensburg	55	−15	23.8	1.05	4.5
Oneonta[1]	51*	−1	27.1	1.75	.....
Oxford	50	−10	25.8	3.35	.....
Palermo	50	0	26.2	2.25	16.5
Penn Yan	52	2	28.3	2.15	15.3
Perry City	51	−3	25.5	2.35	17.5
Phenix	.....	.....	.....	3.20	.....
Pine City	.....	.....	.....	2.90	.....
Plattsburg Barracks †	46	−7	23.5	2.07	.....
Port Jervis	56	−3	27.4	2.27	4.5
Poughkeepsie	57	−9	28.7	2.14	.....
Primrose	57	5	30.6	2.63	1.0
Ridgeway	52	6	27.8	2.34	19.8
Romulus	54	5	29.3	2.01	12.8
Rose	.....	.....	.....	1.49	.....
St. Johnsville	51	−12	25.8	2.56	8.1
Saranac Lake	50	−24	19.3	1.93	29.0
Saratogo Springs	46	−15	25.0	1.91	8.5
Schenectady	52	−8	27.6	.....	.....
Setauket †	54	11	33.8	2.38	1.0
Sherwood	.....	.....	.....	1.87	.....
Skaneateles	.....	.....	.....	3.12	.....
South Canisteo	52	1	25.9	2.62	20.9
Southeast Reservoir	.....	.....	.....	3.17	.....
South Kortright †	56	−4	25.2	1.87	.....
Straits Corners	45	−7	25.4	1.84	11.8
Ticonderoga	48	−11	26.8	1.43	6.8
Wappingers Falls	54	−3	30.8	2.45	6.0
Warwick	.....	.....	.....	2.46	.....
Watertown	52	−19	25.6	5.65	.....
Waverly †	60	−8	27.4	2.75	5.7
Wedgwood	53	−2	25.6	1.98	16.0
West Berne	42	−10	23.6	3.10	28.0
Westfield	55	9	29.9	3.29	10.7
Westpoint †	49	1	27.4	2.41	.....
Willetspoint	58	10	33.1	3.87	4.0
North Carolina.					
Abshers	72	6	39.4	4.40	
Asheville	.....	.....	.....	2.51	T.
Beaufort †	63	24	47.0	4.47	
Biltmore †	66	7	38.8	2.59	T.
Bryson City †	.....	.....	.....	2.55	
Chapel Hill	69	11	41.8	2.07	
Edenton	63	16	43.0	3.40	
Experimental Farm	67	16	43.4	1.34	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
North Carolina—Cont'd.	°	°	°	*Ins.*	*Ins.*
Fairbluff †	.....	.....	.....	2.78	
Fayetteville †	71	11	44.8	2.86	
Flatrock	65	2	37.8	5.11	T.
Greensboro †	66	13	40.0	2.67	
Henderson †	67	13	41.6	2.39	
Hendersonville	67	4	39.0	3.95	
Horse Cove	63	8	38.6	5.31	0.3
Lenoir *†[1]	59	7	38.8	4.52	T.
Linville †	54	−4	31.8	3.41	4.0
Littleton †	66	12	40.5	2.71	
Louisburg †	67	9	41.9	2.00	
Lumberton †	71	18	44.4	2.71	
Mana	.....	.....	.....	2.02	T.
Marion	67	8	39.8	5.54	T.
Marshall	63	2	37.2	1.34	1.5
Mocksville	70	8	42.6	3.11	T.
Moncure †	69	11	44.2	1.33	
Monroe †	70	6	43.0	1.11	
Morganton	72	7	42.5	4.65	
Mountairy	.....	7	.....	3.24	T.
Mount Pleasant	69	8	42.1	2.13	T.
Murphy †	.....	.....	.....	1.09	
Newbern	75	21	47.4	1.48	
Oakridge †	65	13	41.2	3.09	
Pantego	.....	.....	.....	2.57	
Patterson *[1]	63	10	35.6	4.00	
Pittsboro †	69	5	41.8	1.75	T.
Rockingham †	.....	.....	.....	1.55	
Salem †	66	7	39.0	3.94	
Salisbury †	69	10	41.8	1.92	
Saxon †	68	5	41.2	2.53	
Selma	71	10	42.8	4.10	
Settle	63	6	38.0	2.72	T.
Sloan †	75	18	46.5	3.31	
Soapstone Mount †	68	5	39.2	1.81	T.
Southern Pines *a* †	70	15	46.5	1.82	
Southern Pines *b*	70	15	46.1	1.50	
Southport †	71	24	48.6	2.60	T.
Tarboro [k]	72	10	45.2	2.69	
Washwoods	.....	.....	.....	2.29	
Waynesville †	63	2	36.5	2.26	T.
Weldon †	67	12	40.2	2.62	
North Dakota.					
Amenia	48	−26	10.2	0.19	1.9
Ashley	45	−27	11.3	0.30	3.0
Berlin	54	−30	12.0	0.32	3.2
Bottineau	32	−32	6.0	0.50	5.0
Buxton	46	−23	9.2	T.	T.
Churchs Ferry	44	−23	10.4	0.14	1.4
Coal Harbor	52	−19	14.4	0.15	1.5
Devils Lake	44	−23	8.3	0.20	2.0
Dickinson	45	−16	16.6	0.80	8.0
Ellendale	55	−25	15.0	0.10	1.0
Fargo †	47	−30	8.0	0.22	2.2
Forman	55	−30	12.8	0.87	0.3
Fort Berthold	52	−26	12.2	0.29	2.9
Fort Yates	.....	.....	.....	0.15	1.5
Fullerton	53	−29	12.4	0.45	4.4
Gallatin	44	−32	9.3	0.41	4.1
Goetz	48	−18	16.5	0.11	1.1
Grafton	35	−24	8.4	0.15	1.5
Hamilton	42	−33	7.4	0.47	4.7
Kelso	46	−20	12.6	.....	.....
Larimore †	44	−25	11.0	0.05	0.5
McKinney	44	−25	8.8	0.05	0.5
Medora †	55	−14	18.0	0.25	2.5
Melville	51[e]	−23	12.6	T.	T.
Milton †	35	−31	5.1	0.30	3.0
Minnewaukon	46	−26	10.7	0.06	0.6
Minot	48	−17	16.4	0.05	.....
Minto † [g]	43	−26	10.9	.....	.....
Napoleon †	45	−24	13.3	0.40	4.0
New England City	37	−20	12.8	0.20	2.0
Oakdale	50	−16	22.4	0.12	1.2
Portal	42	−22	13.8	.....	.....
Power †	52	−35	12.4	0.02	0.2
Sheyenne	48	−23	13.2	0.11	1.1
Steele	48	−23	14.1	T.	T.
Towner †	45	−27	10.9	.....	.....
University	40	−31	13.8[e]	0.50	5.0
Valley City †	50	−25	11.7	0.30	3.0
Wahpeton †	54	−27	14.0	0.45	4.5
Washburn	.....	−22	.....	0.06	0.6
Willow City	37[e]	−30[e]	10.2[e]	T.	T.
Woodbridge †	42	−38	7.2	0.26	2.6
Ohio.					
Akron	56	0	28.2	2.71	8.8
Annapolis	58	0	27.3	1.02	3.0
Ashland	55	2	27.6	2.49	21.8
Ashtabula	62	8	29.6	4.64	20.0
Atwater	.....	.....	.....	2.49	8.1
Bangorville	54	−7	25.6	2.95	12.5
Bellefontaine	55	−2	25.4	.....	.....
Benton Ridge	55	0	27.8	3.51	20.0
Bethany	58	−3	30.5	2.57	8.0
Bigprairie	55	−1	28.8	3.40	18.0

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Ohio—Cont'd.	°	°	°	*Ins.*	*Ins.*
Binola	.....	.....	.....	2.82	12.5
Bloomingburg	60	−4	29.3	3.20	6.0
Bowling Green	55	−2	26.8	1.57	6.6
Bucyrus	55	−10	28.8	1.25	8.5
Cambridge	60	−13	28.2	2.73	2.0
Camp Dennison	59	−11	30.3	2.94	2.3
Canal Dover	59	−3	28.8	3.18	4.5
Canton	59	3	29.8	2.80	3.9
Carrollton	59	0	28.2	3.85	12.0
Cedarville	.....	.....	.....	2.55	6.5
Celina	54	−5	26.5	1.85	8.0
Circleville	62	−5	31.6	3.40	7.0
Clarksville	67	−4	30.5	3.27	6.0
Cleveland *a*	55	3	29.8	2.77	13.5
Cleveland *b*	56	5	28.0	.....	.....
Coalton	64	−15	30.0	2.98	11.0
Colebrook	53	−1	26.6	1.69	8.5
Dayton *a*	59	−15	29.6	3.05	10.5
Dayton *b*	.....	.....	.....	1.87	6.6
Defiance	55	−4	26.4	2.40	8.6
Delaware	57	−3	28.2	1.82	7.4
Demos	60	−6	27.8	1.55	6.0
Dupont	53	−4	26.9	2.80	9.0
Elyria	56	2	28.0	2.39	13.4
Findlay	57	2	27.6	2.51	8.5
Frankfort	63	−5	30.9	2.85	6.5
Garrettsville	57	0	27.5	3.19	16.0
Granville	59	−9	28.4	3.58	6.8
Gratiot	57	−8	28.8	2.78	6.1
Greenfield	60[b]	3[c]	32.6[c]	2.95	3.0
Greenhill	56	−7	27.1	3.04	9.0
Greenville	53	−3	27.6	2.94	9.0
Hackney	.....	.....	.....	2.79	9.5
Hanging Rock	65	−4	35.2	2.07	3.4
Hedges	54	−10	26.5	2.50	12.5
Hillhouse	54	0	26.8	3.72	23.0
Hillsboro	62	−15	31.1	3.32	5.0
Hiram	54	0	26.8	2.68	15.5
Hudson	54	0	27.2	.....	.....
Jacksonboro	58	−4	29.0	2.85	10.0
Kenton	65	−1	28.8	3.04	15.5
Killbuck	58	−1	28.4	2.30	5.0
Lancaster	55	−4	29.2	3.76	4.0
Leipsic	54	−5	27.0	2.58	8.8
Levering	55	−5	26.8	2.63	12.5
Logan	66	−14	32.2	2.68	.....
Lordstown	57	−1	27.0	2.36	13.0
McArthur	62	−18	30.1	2.73	8.0
McConnelsville	63	−9	33.2	2.81	4.5
Mansfield	.....	.....	.....	4.30	4.6
Marietta *b*	64	0	33.4	2.21	8.0
Marion	57	−1	28.6	1.65	9.8
Medina	57	−1	28.1	3.76	16.0
Milfordton	54	0	25.6	2.52	6.1
Milligan	61	−18	29.2	2.28	6.0
Millport	56	−9	26.4	3.20	11.0
Montpelier	52	−3	25.7	2.55	8.5
Napoleon	55	−5	27.8	3.06	7.5
Neapolis	.....	.....	.....	3.19	7.5
New Alexandria	60	1	30.4	2.10	5.0
New Berlin	57	−2	26.6	2.28	7.5
New Holland	62	−4	30.0	4.02	8.8
New Paris	56	−8	27.2	2.91	14.8
New Waterford	57	1	29.0	3.48	19.5
North Lewisburg	64	−5	28.1	2.45	12.5
North Royalton	54	0	27.7	2.63	15.0
Norwalk	56	−1	28.2	1.69	10.5
Oberlin	58	0	28.6	2.89	.....
Ohio State University	58	−1	29.7	3.07	5.1
Orangeville	56	0	26.2	2.20	7.5
Ottawa	54	2	29.2	2.48	10.5
Pataskala	58	−6	28.4	3.44	6.7
Perry	.....	.....	.....	2.40	14.0
Philo	57	−1	28.4	2.45	4.0
Plattsburg	56	−4	28.2	2.97	14.0
Pomeroy	64	−4	32.6	1.32	2.0
Portsmouth *a*	.....	.....	.....	2.76	3.0
Portsmouth *b*	66	1	34.6	3.12	7.0
Richwood	58	−6	28.2	2.49	11.2
Ridgeville Corners	53	−4	26.4	2.14	7.0
Ripley	62	−8	31.0	3.09	6.8
Rittman	55	−2	26.3	1.78	8.0
Rockyridge	55	3	27.4	2.73	7.0
Rosewood	54	−4	27.4	2.62	7.0
Seaman	62	−9	30.2	2.66	6.2
Shenandoah	54	0	26.3	2.59	8.4
Sidney *b*	55	−1	27.2	2.63	8.1
Sinking Spring	60	−4	30.4	3.65	8.8
Somerset †	.....	.....	.....	2.58	1.0
Springboro	.....	.....	.....	2.30	.....
Strongsville	.....	.....	.....	6.04	13.5
Sylvania	50	−3	23.8	2.61	7.0
Thurman	65	−2	34.1	2.69	4.0
Tiffin	55	0	28.0	3.30	11.5
Upper Sandusky	57	0	28.4	3.14	8.0
Urbana	55	−6	27.5	2.42	12.5

TABLE II.—*Meteorological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	Ins.	Ins.
Ohio—Cont'd.					
Vanceburg	63	-6	33.0	3.47	3.0
Vanwert	57	-2	27.6	2.25	8.0
Vermillion	58	1	28.7	2.53	10.0
Vickery	55	-1	27.8	2.43	6.0
Walnut				2.85	8.2
Warren	55	1	28.4	4.37	17.4
Warsaw	59	-2	28.3	2.35	6.5
Wauseon	54	-5	26.2	3.28	11.2
Waverly	65	-5	31.9	3.41	6.5
Waynesville	54	-6	27.2	3.16	13.5
Wellington	56	3	28.3	2.82	9.0
Westerville	57	-2	30.1	2.34	6.2
Willoughby				3.11	6.0
Wooster *b*	56	1	27.9	2.29	10.8
Youngstown	54	3	28.2		
Zanesville				2.65	3.5
Oklahoma.					
Anadarko	76	4	37.2	2.30	
Arapaho †	71	3	32.9	2.09	2.5
Burnett †	71	5	34.8	2.53	0.2
Clifton †	67	3	34.6	2.76	2.0
Edmond				2.60	1.0
Fort Sill	77	6	35.4	2.40	
Guthrie	70	7	35.9	3.01	1.1
Hennessey				3.48	4.5
Hopeton	63	1	31.0	2.36	6.0
Jefferson	70	3	33.4	2.84	5.0
Kingfisher	69	5	35.0	2.52	3.0
Mangum †	76	1	34.6	2.14	5.0
Norman	68	0	31.7	2.38	0.5
Pawhuska	68	5	35.0	5.20	7.0
Perry	64	0	31.7	2.48	2.5
Prudence	64	-2	34.2	2.85	3.0
Sac and Fox Agency	67	4	36.4	4.20	2.0
Stillwater †	65	7	36.0	2.68	1.2
Waukomis	68	5	35.2	2.53	2.5
Winnview [f]	58	4	34.4	3.05	1.5
Oregon.					
Albany *a*	55	18	40.0	3.64	1.5
Albany *b*				3.45	3.0
Arlington	59	1	30.9	1.01	6.0
Ashland *b*	62	20	38.7	1.16	1.9
Aurora *[1]	55	17	37.0	3.57	2.0
Aurora (near)	55	17	37.7	3.87	0.8
Bandon	64	28	47.2	4.32	
Bay City †	57	25	42.2	12.00	
Beulah	44	-7	20.4	0.30	2.8
Brownsville *[1]	52	18	38.8	2.95	0.5
Burns	45			0.20	2.0
Cascade Locks	53	15	34.2	8.16	6.0
Comstock *[1]	54	16	37.7	4.91	3.0
Coquille River				4.97	
Corvallis	54	18	37.6	3.62	3.0
Dayville †	55	-1	30.8	1.09	0.2
Eugene				4.26	1.0
Ella				0.30	T.
Fairview	58	21	42.4	6.35	13.3
Falls City	58	17	36.4	7.11	5.6
Forestgrove	64	14	34.6	5.81	7.0
Gardiner	56	30	43.6	6.08	
Glenora	54	19	37.5	14.23	12.5
Government Camp	47	10	30.2	12.10	58.0
Grants Pass *a* †	56	15	37.1	2.26	8.0
Happy Valley	55	-10	23.9	0.59	2.5
Heppner	59	-6	27.5	1.47	10.4
Hood River (near)	53	7	30.8	4.17	6.0
Jacksonville	55	19	36.6	1.64	2.5
Joseph	44	-3	19.4	0.80	8.0
Junction City *[1]	72	20	39.3	1.98	3.5
Kerby	55	7	37.2	4.04	6.0
Klamath Falls	46	10	28.9	1.53	7.0
Lafayette *[1]	48	12	38.5	2.91	3.0
Lagrande	48	-3	26.3	1.31	4.0
Lakeview †	46	0	26.1	1.50	12.0
Langlois	68	27	48.7	8.32	
McMinnville	53	17	37.5	4.21	1.0
Merlin *[1]	56	11	31.4	1.97	8.0
Monmouth *a* *[1]	53	20	37.7	3.65	2.0
Monmouth *b*	54	18	39.0	2.52	8.0
Monroe	55	19	37.8	3.67	7.0
Mount Angel †	58	18	37.0	4.40	0.5
Nehalem				16.51	0.5
Newberg	53	18	37.4	3.11	0.7
Newbridge				0.49	3.0
Newport	56	29	45.0	5.83	
Pendleton	60	-5	28.8	0.89	3.0
Placer				2.64	17.0
Prineville	70	-5	27.0	0.70	
Riddles *[1]	55	18	36.0	3.06	12.0
Riverside	50	-8	23.2	0.28	6.0
Salem *b* †	56	16	37.8	4.31	3.0
Sheridan *[1]	53	19	37.9	4.41	0.0
Silver Lake	50	-10	24.0	0.38	T.
Silverton *[1]	54	16	39.2	4.79	0.5
Siskiyou *[1]	52	24	36.2	3.00	30.0
Sparta	40	5	23.0	2.80	26.0
Oregon—Cont'd.					
Springfield *[1]	52	18	36.6	2.87	2.0
Stafford	52	19	36.6	3.56	3.0
The Dalles †	57	7	32.6	1.14	3.2
Tillamook Rock				5.37	
Toledo	60	25	44.0	4.85	T.
Umatilla				0.37	0.5
Vale	43	-6	22.0	0.45	3.5
Vernonia		13		5.31	17.0
West Fork *[1]	49	19	35.6	2.21	10.0
Weston	53	-5	25.4	1.71	11.8
Williams		14		1.85	5.5
Pennsylvania.					
Altoona	58	4	28.4	2.67	
Aqueduct	61	6	32.4	2.12	4.6
Athens	58	-2	28.0	1.61	5.2
Beaver Dam				2.08	11.6
Bethlehem				3.50	
Brookville †				2.04	11.4
Browers Lock				3.93	
Cameron				1.94	5.0
Carlisle	50	5	29.8	2.92	5.5
Cassandra	59	0	28.6	2.61	16.5
Cedarrun				3.75	16.0
Centerhall †	52	5	28.4	3.90	17.0
Chambersburg †	60	0	29.7	3.23	4.0
Coatesville	63	9	32.8	4.45	2.0
Confluence †				3.19	11.0
Coopersburg	63	13	33.6	3.78	
Davis Island Dam †				2.03	0.4
Derry Station	58	4	29.6	2.83	10.5
Doylestown				3.74	
Driftwood				3.06	
Duncannon				3.55	9.8
Dushore	55	-5	26.4	2.37	11.8
Dyberry	54	-11	24.8	2.66	11.0
East Bloomsburg				0.42	0.1
East Mauch Chunk	61	1	29.3	3.75	5.0
Easton	53	7	31.3	3.12	1.2
Ellwood Junction †				2.56	4.2
Emporium	54	-2	28.4	2.66	8.5
Everett	60[e]	2	29.4	2.84	5.5
Farrandsville				2.70	10.0
Forks of Neshaminy *[1]	56[e]	14	33.4[e]	3.40	
Franklin	56	5	27.8	1.31	
Frederick				3.99	
Freeport †				2.76	6.7
Girardville				3.02	15.0
Grampian	56	-2	25.5	3.56	20.0
Greensboro †	66	-8	31.0	2.81	7.0
Hamburg	57	6	31.6	3.02	3.5
Hawley	57	-10	27.8	3.62	
Hews Island Dam				2.17	
Hollidaysburg	62[e]	0[e]	30.6[e]	2.94	
Huntingdon *a* †	59	3	31.2	2.26	7.0
Huntingdon *b*				2.41	2.0
Irwin				3.14	
Johnstown †	63	0	31.2	3.35	8.5
Karthaus				1.91	13.0
Keating				2.98	4.9
Kennett Square	62	8	33.6	4.24	0.2
Lansdale				3.62	
Lebanon	60	4	30.8	3.41	4.4
Leroy †	55	2	26.7	1.58	9.1
Lewisburg	61	-2	29.0	2.44	7.2
Lock Haven *a* †	50	2	29.7	3.98	12.5
Lock Haven *b*				2.14	12.0
Lock No. 4 †				1.98	7.0
Lycippus	64	3	29.9	3.31	16.4
Mifflin				3.40	0.2
Nisbet				3.55	11.7
Oil City †				2.90	13.4
Ottsville				3.49	
Parker †				1.99	8.0
Philadelphia *b*	60	16	36.0	3.98	0.8
Point Pleasant				3.42	
Quakertown	59	9	31.4	4.47	3.0
Reading [2]			30.8	3.36	
Renovo *a*				2.73	7.0
Renovo *b*	49	3	29.0	2.97	8.8
Ridgway †				2.17	12.7
Saegerstown	58	5	28.6	3.09	14.9
St. Marys		2		2.01	
Salem Corners	54	0	26.4	3.33	19.3
Scranton	57	-3	28.9	2.27	10.0
Seisholtzville				3.28	
Selinsgrove	59	3	30.8	2.72	8.0
Shawmont				3.36	
Shinglehouse	60	4	26.3	2.35	12.0
Sinnamahoning				2.55	
Smethport	52	-1	25.8	2.10	10.0
Smiths Corners				3.60	
Somerset	48	0	25.4	4.79	28.8
South Bethlehem	62	6	27.4		
South Eaton	59	-1	29.6	2.02	5.0
State College	56	7	28.0	3.07	15.4
Sunbury				1.15	9.0
Pennsylvania—Cont'd.					
Swarthmore	57	13	32.8	3.33	
Towanda	50	-8	28.8	1.97	4.5
Trout Run				3.81	7.5
Uniontown	65	7	32.8	3.64	16.0
Warren †	68	3	28.8	3.17	20.9
Wellsboro †	54	4	28.2	2.68	16.0
West Chester	59	11	33.6	4.46	1.0
West Newton †				2.10	8.0
White Haven	59	-6	27.8	2.51	8.0
Wilkesbarre †	59	3	29.6	1.95	6.0
Williamsport	48	7	29.1	2.86	11.3
York †	62	3	31.0	3.58	7.0
Rhode Island.					
Bristol	47	6	32.5	1.89	3.5
Kingston	50	-4	29.4	2.71	1.8
Lonsdale				2.45	8.0
Pawtucket	54	0	31.4	2.19	3.5
Providence *a*	54	2	32.5	2.54	4.0
Providence *c*	54	-2	30.6	2.33	6.0
South Carolina.					
Allendale [f]	72	15	42.3	3.08	
Anderson †				3.16	
Batesburg †	74	21	45.7	1.96	T.
Blackville †	75	24	47.4	3.33	
Camden †				1.54	
Central	66	12	42.8	4.13	T.
Cheraw *a* †	71	14	43.5	1.02	
Cheraw *b* †				1.77	
Clemson College *a*	68	11	41.2	3.68	T.
Conway †				3.51	
Darlington				1.42	
Edisto †				2.31	
Effingham †				3.72	
Florence	72	19	46.1	2.15	
Gaffney †				3.17	
Georgetown	75	26	50.2	4.15	
Gillisonville	77	24	49.4	6.52	T.
Greenville †	69	9	40.6	3.29	
Greenwood	69	17	39.8	2.22	
Holland	69	9	43.0	3.58	
Kingstree *a* †	74	27	48.8	2.39	
Kingstree *b*				2.43	
Little Mountain	72	15	44.6	1.28	
Longshore †	71	17	45.2	1.95	
Mount Carmel †				3.41	
Pinopolis *[1]	68	29	48.3	4.15	
Port Royal †	68	31	49.9	2.23	
St. Georges †	75	26	48.4	3.55	
St. Matthews †	73	22	47.9	2.02	
St. Stephens †				4.15	
Santuck †	68	10	43.0	1.74	
Shaws Fork	68	19	43.8	2.39	
Smiths Mills †				3.45	
Society Hill †	69	20	45.4	1.28	
Spartanburg	67	16	43.0	3.73	T.
Statesburg †	74	20	48.0	1.47	T.
Summerville	73	26	49.7	3.70	
Trenton [e]	70	23	47.8	2.28	
Trial	73	24	47.2	4.97	
Walhalla	67	9	42.0	5.45	T.
Winnsboro	66	17	43.8	1.26	
Yemassee †	75	27	48.4	4.81	
Yorkville	71	18	45.2	2.09	
South Dakota.					
Aberdeen †	57	-23	14.7	0.20	2.0
Alexandria	53	-20	19.0	T.	T.
Armour	60	-16	20.6	0.20	2.0
Ashcroft †	59	-21	23.1	0.27	2.5
Brookings †	52	-22	14.9	0.00	0.0
Canton	49			0.10	1.0
Centerville				0.14	1.9
Chamberlain	64	-14	22.0	0.01	0.1
Chandler	63	-15	22.2	0.13	1.8
Clark				0.05	0.5
Desmet	57	-20	15.1	0.10	1.0
Doland	56	-29	15.3	0.14	2.0
Elkpoint	54	-13	20.2	T.	T.
Farmingdale				0.05	0.5
Flandreau	50	-20	12.8	T.	T.
Forestburg †	58	-27	15.2	T.	T.
Forest City	47	-18	17.4	0.20	2.0
Fort Meade †	60	-12	23.6	1.10	11.0
Gann Valley	59	-20	20.0	T.	T.
Gary	49	-16	15.3	0.00	0.0
Goudyville	44	-22	15.9	0.01	0.1
Harney	60[j]	-16[h]	24.1[i]	0.05[f]	[f]0.5
Hotch City †	60	-16[g]	20.2[d]	0.09	1.2
Hot Springs	55	-15	22.7	0.10	1.0
Howard †	55	-23	16.2	0.10	1.0
Interior	60	-15	20.1	0.05	0.5
Ipswich				0.05	0.5
Kimball †	58	-15	20.6	0.25	2.3
Leslie	47	-20	20.8	T.	T.
Menno †	56	-18	19.2	0.15	1.5
Mitchell †	58	-18	20.0	0.06	0.5
Montrose	52	-19	16.4	T.	T.

TABLE II.—*Meteorological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
South Dakota—Cont'd.	°	°	°	*Ins.*	*Ins.*
Nowlin	60	−18	20.6	T.	T.
Oelrichs	58	−19	21.0	0.55	5.5
Parker	52	−20	17.2	0.10	1.0
Plankinton†	59	−19	19.2	0.15	1.5
Redfield	58	−21	17.0	T.	T.
Rochford	54	−26	21.8	0.62	5.7
Shiloh		−20		T.	T.
Sioux Falls†	48	−22	15.1	0.10	1.0
Spearfish†	59	−11	27.2	0.40	11.5
Tyndall†	53	−15	21.2	0.05	0.5
Watertown	47	−25	12.9	T.	T.
Waubay	52	−23	12.8	T.	T.
Wentworth†	51	−18	15.8	0.05	0.5
Wessington Springs	58	−18	17.6	T.	T.
Whiteswan	62	−12	23.9	0.17	1.7
Wolsey				0.16	1.5
Tennessee.					
Andersonville	63	4	35.2	2.35	6.0
Ashwood	67	10	39.7	2.50	2.5
Benton (near)†	68	10	39.0	2.76	
Bluff City†				1.39	1.0
Bolivar†[5]	66	6	38.2	2.78	0.5
Bristol†	60	0	33.2	1.44	
Byrdstown	68	−2	36.6	2.40	4.9
Carthage†	67	5	38.8	2.51	
Charleston				2.37	0.2
Clarksville	64	4	37.0	3.98	1.3
Clinton				1.98	1.0
Decatur†	65	10	38.8	2.86	1.0
Dover	68	8	37.9	4.00	8.6
Elizabethton†	67	6	34.5	1.23	1.2
Elk Valley		−2		2.78	4.6
Erasmus	66	3	35.1	2.48	2.7
Florence†	66	8	38.8	2.56	2.0
Franklin	66	9	38.2	2.84	3.0
Grace *[1]	58	8	35.5	1.25	3.0
Greeneville†	66	8	36.0	1.33	0.9
Harriman	68	10	38.0	2.53	0.5
Hohenwald†	63	2	37.5	3.10	6.0
Johnsonville	65	−3	37.0	3.27	7.6
Jonesboro*[1]	64	7	34.0	2.03	3.9
Kingston†				2.34	T.
Lafayette*[5]	63	2	35.9	1.75	8.0
Liberty	67	8	38.2	1.00	
Lynnville†	66	10	39.8	3.00	2.0
McKenzie†	60	5	38.4	4.20	0.8
McMinnville	69	4	38.4	1.25	1.0
Madison	67	−1	36.4	2.60	4.7
Maryville*[5]	67	11	39.0	1.87	1.0
Newport†	70	9	36.8	1.28	
Nunnelly	64	1	37.4	2.41	0.5
Oak Hill	69	−1	37.8	1.38	2.4
Palmetto†	69	11	38.9	2.86	4.0
Peryear*[5]	65	10	38.6	3.25	T.
Pope	65	0	37.2	2.86	4.2
Rogersville†	66	2	35.0	1.85	2.5
Rugby	64	−6	35.2	3.59	3.0
St. Joseph	66	7	38.9	1.52	2.0
Savannah	66	8	39.2	2.94	
Sewanee†	67	6	37.6	2.30	1.2
Silverlake	56	−3	31.2	1.97	5.0
Springdale	66	−8	35.8	2.88	5.4
Springfield	67	−2	36.9	3.25	5.5
Sylvia	62[c]	7[c]	37.4[c]	3.05	7.5
Tazewell				2.14	6.5
Tellico Plains†	70	10	39.2	1.74	
Tracy City	64	1	36.2	2.94	1.5
Trenton	65	6	38.0	3.80	6.5
Tullahoma†	68	5	38.2	2.50	5.5
Union City	55	−2	35.6	2.45	6.0
Waynesboro	65	4	37.8	2.85	3.0
Wildersville	64	8	38.2	2.92	5.2
Yukon	71	8	39.9	2.95	0.3
Texas.					
Albany*[1]	68	12	39.2	2.25	10.0
Alvin				2.91	
Anna	75	11	40.6	3.35	1.5
Anson				1.51	8.0
Arthur City†				2.22	
Austin *a*	72	15	42.9	1.55	3.0
Austin *b**[1]	73	12	40.7		
Ballinger†	75	9	38.2	2.37	4.3
Beaumont				2.00	
Beeville†	85	22	49.4	1.78	
Blanco	72	20	48.8	1.90	5.0
Boerne*[1]	73	15	43.9	2.77	7.5
Brazoria†	78	24	49.4	2.48	
Brenham†	78	17	47.4	4.08	T.
Brighton	82	27	53.2	0.94	
Brownwood	78	8	40.4	2.60	3.0
Burnet*[1]	74	11	40.7	2.20	3.0
Coleman	79	6	41.9	2.00	4.0
Colorado				2.34	8.0
Columbia†	78	23	48.8	2.74	
Conroe	74	21	47.5	2.83	
Corsicana *b*†	74	12	41.9	3.60	3.0

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Texas—Cont'd	°	°	°	*Ins.*	*Ins.*
Cuero†				1.80	
Dallas†	76	10	40.0	2.60	4.0
Danevang†	78	22	49.0	2.88	
Dublin†	75	6	39.1	1.61	4.5
Duval	75	16	46.9	1.53	3.0
Emory		12		2.80	4.0
Estelle†	78	8	40.2	3.64	6.0
Forestburg				2.34	2.4
Fort Brown	83	31	55.2	0.18	
Fort McIntosh	87	25	50.0	0.54	
Fort Ringgold	92	24	53.9	T.	
Fort Stockton				0.92	1.0
Fredericksburg*†[1]	78[c]	14	41.8[c]	1.75	4.9
Fruitland	78	5	39.3	2.21	4.2
Gainesville	68	4	40.3	3.33	5.0
Georgetown*[1]	72[c]	15[b]	41.8[c]	1.90	3.0
Golindo				2.55	3.0
Grapevine	78[c]	5[b]	39.4[c]	2.37	6.0
Hale Center†	68	9	36.0	1.22	6.5
Hallettsville†	76	22	48.0	2.13	
Hewitt				2.85	4.0
Honeygrove				2.42	3.0
Houston†	79	26	49.4	2.94	T.
Hulen	77	25	49.9	2.86	
Huntsville†	75	18	45.4	3.47	1.5
Jacksonville	76	14	45.0	4.08	4.0
Jasper	78	25	50.2	2.21	0.5
Junction				1.44	4.5
Kent				1.51	8.0
Kerrville	79	13	41.8	1.75	6.0
Lampasas†	68	10	39.3	1.98	4.0
Llano*†[5]	75	15	43.8	1.30	3.5
Longview†	74	13	42.8	2.55	6.0
Luling†	76	18	46.4	1.68	2.5
Mann	72[c]	8[c]	42.8[c]	3.05	4.5
Menardville	75	7	39.0	2.13	3.0
Mount Blanco†	73	1	35.0	1.74	7.0
New Braunfels†	73	20	46.6	1.53	3.6
Panter				2.62	3.0
Point Isabel*[1]	78	36	56.7	T.	
Rheinland†	76	0	38.0	1.54	4.5
Rockport*[1]	72	30	53.0		
Rock Springs				2.08	8.8
Runge†	81	21	51.0	1.21	
Sabine Pass	71	29	50.6	2.20	
San Antonio	76	21	47.6	1.08	0.2
Sanderson	83				
San Marcos *b*†	71	18	41.5	1.32	
Sherman	71	11	42.6	2.50	3.0
Temple *a*	75	13	41.6	2.20	8.0
Temple *b*	76	10	43.6		
Tulia	67	−2	30.4	1.70	10.5
Tyler	73	12	43.7	3.30	5.0
Victoria				1.70	
Waco	82	14	47.2	2.30	3.0
Waxahachie†	75	9	41.0	3.42	2.2
Weatherford†	75	9	39.7	2.83	2.8
Wichita Falls†				2.77	4.0
Utah.					
Alpine				0.63	
Blue Creek*[1]	38	−3	19.4	0.70	5.5
Brigham				1.08	
Corinne	49	−11	20.8	0.65	6.5
Fillmore†	57	0	25.6	0.76	
Fort Duchesne†	35	−17	10.4	0.10	1.0
Frisco	54	4	28.6	0.24	3.0
Giles	47	−11	18.4	0.25	4.5
Heber	46	−15	18.0	1.10	11.0
Huntsville				1.10	8.0
Kelton*[1]	45	0	14.9	0.20	2.0
Levan†	44	−7	21.2	1.36	13.6
Logan	39	−5	16.5	0.48	
Manti	60	−9	23.1	0.45	4.5
Millville				0.66	
Minersville	55	−3	25.2	0.29	2.8
Moab†	53	0	26.0	0.22	0.8
Mount Pleasant†	49	−5	24.2	0.50	5.0
Ogden *a**[1]	46	0	25.0	0.60	6.0
Pahreah	53	6	27.4	0.10	1.0
Parowan†	55	−8	23.8	0.82	8.2
Pinto	51	−9	24.8	0.11	1.1
Promontory*[1]	45	0	26.0	0.10	1.0
Provo	49	0	26.4	0.80	
Richfield†	61	−3	30.6		
St. George†	63	1	31.6	0.12	2.0
Scipio	48	−14	20.1	1.10	8.0
Snowville	39	−8	17.6	0.60	6.0
Soldier Summit	44	−7	17.2	1.15	11.5
Terrace*[1]	31	−10	10.3	0.65	6.5
Tooele†	50	5	24.2	0.80	
Tropic	52	1	27.1	T.	T.
Vernal	37	−6	16.0	0.17	1.7
Vermont.					
Bennington	56	−15	27.1	1.95	9.0
Brattleboro	57	−17	25.7	2.56	11.5
Burlington	49	−5	27.6	0.75	5.0

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Vermont—Cont'd.	°	°	°	*Ins.*	*Ins.*
Chelsea	45	−17	21.2	1.26	14.0
Cornwall	45	−4	24.6	1.05	2.5
Enosburg Falls	55	−26	22.9	4.23	40.0
Hartland	43	−24	21.8	1.75	8.7
Jacksonville	45	−24	18.6		
Norwich	44	−24	21.4	1.54	5.5
St. Johnsbury	41	−25	21.0	1.46	11.0
Vernon*[6]	44	−20	24.7	2.20	10.0
Wells	52	−11	24.2	1.79	5.2
Woodstock	42	−30	21.4	1.65	10.0
Virginia.					
Alexandria	68	12	36.2	3.86	1.1
Ashland†	69	9	39.1	3.33	T.
Bedford City	65	10	38.4	4.16	1.5
Bigstone Gap†	63	0	33.4	3.05	4.5
Birdsnest*[1]	68	18	42.7	1.60	0.5
Blacksburg	68	1	33.3	2.68	1.5
Buckingham†	67	7	36.2	3.56	1.0
Burkes Garden	74	0	31.0	2.60	3.0
Callaville†	66	9	40.8	1.93	
Charlottesville	62	15	39.0	5.70	T.
Christiansburg				2.54	1.1
Clarksville				1.65	
Clifton Forge	49	10	32.6	2.33	T.
Colemans Falls	69	9	40.9	4.09	2.0
Columbia				6.10	T.
Dale Enterprise†	63	1	32.6	3.60	5.0
Doswell	56	6	32.8	1.16	T.
Dwale				2.95	2.5
Farmville	70	10	39.5	3.35	0.7
Fredericksburg†	69	9	36.8	4.01	1.0
Grahams Forge	60[c]	4[c]	31.7[c]	1.53	T.
Hampton	64	22	43.4	1.35	T.
Hot Springs	59			2.73	4.5
Leesburg	53	10	30.9	3.78	5.0
Lexington†	60	5	34.9	2.90	1.5
Manassas†	67	5	35.6	2.91	1.2
Marion	57[c]	−2[c]	31.8[c]	2.40	4.0
Miller School	65	8	37.2	3.60	1.0
Newport News	66	19	43.4	1.43	T.
Petersburg†	68	13	41.0	2.04	T.
Quantico	62	2	31.8		
Richmond (near)†	68	10	39.5	3.25	T.
Rockymount†	63	10	38.8	4.13	T.
Salem†	69	14	41.2	2.58	0.5
Speers Ferry				2.29	2.0
Spottsville†	74	10	40.2	1.89	T.
Stanardsville†	66	10	37.1	4.20	1.0
Staunton†	65	6	37.3	3.00	5.0
Stephens City†	67	5	34.6	3.53	8.0
Sunbeam†	68	10	42.2		
Tobaccoville	70	8	40.4	4.19	1.0
Warrenton	57	13	36.6	5.26	3.0
Warsaw†	69	9	37.2	2.92	T.
Westbrook	66	14	39.1		
Westpoint	64	12	37.6	2.30	
Williamsburg	57	7	34.7		
Woodstock†	65	5	34.0	2.61	5.0
Wytheville†	60	6	33.8	2.48	1.0
Washington.					
Aberdeen	55[d]	24[d]	37.8[d]	10.92	1.4
Anacortes				2.77	1.0
Ashford†				9.86	18.0
Blaine†	54	7	32.0	2.76	2.0
Bridgeport	58	−5	25.6	0 34	3.4
Brinnon	54	26	38.2	6.31	10.5
Cedar Lake				12.48	23.0
Centerville†	50	−8	26.0	1.29	7.0
Clearwater	54	22	36.3	18.05	6.2
Colfax	50	−6	26.2	0.88	5.3
Coupeville†	56	24	38.8	2.38	2.1
Dayton	60	−7	26.2	0.85	8.5
Ellensburg	48	−5	23.8	0.54	5.4
Ellensburg (near)	40	−4	22.4	0.60	5.0
Fort Simcoe†	60	−2	26.6	1.50	15.0
Fort Spokane	47	−8	18.6	1.00	10.0
Grandmound†	54	14	36.8	5.30	4.6
Hooper	57	−10	25.2	1.15	
Hunters†	47	−3	21.2	1.46	11.5
Kennewick†	71	−8	30.4	0.23	1.5
Lacenter	52	15	36.7	6.14	8.0
Lakeside	45	8	23.5	1.35	13.5
Lapush	59	25	41.6	5.40	T.
Lind	54	−11	22.9	0.71	7.2
Loomis	46	−3	20.8	0.11	2.0
Madrone†	56	24	39.0	5.33	22.5
Mayfield	63	18	37.0	6.70	
Moxee Valley†	67	−4	26.2	0.52	5.2
New Whatcom	60	19	40.0	3.64	5.0
Northbend	56	26	39.7	5.80	10.0
Olga	53	24	39.4	3.42	7.0
Olympia†	56	18	39.6	5.33	3.0
Orcas Island	53	20	39.6	2.71	1.0
Pinehill†	53	6	30.3	2.16	9.4
Pomeroy	64	1	29.0	0.91	3.5
Port Townsend	57	28	40.9	1.84	3.7

TABLE II.—*Meteorological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Washington—Cont'd.	°	°	°	Ins.	Ins.
Pullman†	48	0	25.4	1.06	3.5
Rosalia†	49	− 9	24.2	0.80	5.4
Sedro†	55	18	35.9	4.76	3.0
Silvania	56	17	35.8	3.91	7.2
Snohomish†	57	19	38.4	3.06	12.0
Snoqualmie	......	......	......	5.78	......
Southbend	55	23	41.3	9.10	T.
Stampede	54	14	29.2	4.30	43.0
Sunnyside†	62	− 6	27.2	0.06	0.5
Tunnel	45	10	26.7	9.20	61.0
Union City†	55	22	37.7	9.24	12.0
Usk	45	−13	18.2	1.44	11.0
Vancouver	54	13	36.6	4.49	T.
Vashon	57	27	39.7	4.21	7.0
Waterville	48	− 5	19.6	1.00	10.0
West Virginia.					
Beckley	......	......	......	1.48	5.0
Beverly†	64	− 9	29.8	4.13	25.0
Bluefield	61	− 3	33.1	2.25	3.2
Buckhannon *a*†	......	......	......	3.45	17.5
Buckhannon *b*	63	−12	31.4	......	......
Burlington†	65	1	31.6	2.55	4.0
Charleston†	......	......	......	2.56	2.0
Dayton†	66	−12	32.8	2.37	10.5
Eastbank	66	0	35.1	2.15	4.0
Elkhorn†	64	1	35.0	2.60	8.7
Fairmont†	......	......	......	2.70	11.2
Glenville†	68	−10	31.7	3.81	8.0
Grafton†	65	− 4	33.8	2.48	10.5
Green Sulphur	61	− 2	32.7	2.63	4.0
Harpers Ferry	......	......	......	3.69	4.8
Hinton *a*†	......	......	......	1.94	3.0
Hinton *b*†	57	4	33.2	......	2.5
Huntington	69	0	33.5	2.46	6.5
Kingwood	64	− 3	30.4	2.78	......
Marlinton	......	− 5	......	3.71	11.7
Martinsburg†	63	− 1	32.6	3.50	7.0
New Cumberland [f]	61	4	33.0	1.03	......
New Martinsville	65	− 4	34.0	2.79	6.5
Nuttallburg	65	− 9	34.2	......	......
Oldfields†	67	3	31.5	2.74	8.2
Philippi *a*	66	− 8	33.5	2.49	10.0
Point Pleasant†	65	− 5	33.8	2.57	4.0
Powellton	64	1	33.0	2.99	6.5
Romney	63	6	33.2	2.69	3.0
Rowlesburg†	......	......	......	2.98	29.8
Upper Tract	65	3	33.0	1.99	6.5
Weston *a*	......	......	......	3.13	11.8
Weston *b*	66	− 9	33.2	......	11.0
Wheeling *a*†	......	......	......	3.06	6.5
Wheeling *b*†	66	4	33.3	2.68	7.0
Wisconsin.					
Amherst	40	−18	14.7	0.81	5.0
Barron	......	−30	......	T.	T.
Bayfield	40	−20	16.6	1.75	17.5
Beloit	47	− 8	19.8	0.23	2.2
Brodhead	48	− 9	18.5	0.37	1.0
Butternut	42	−31	13.4	0.25	2.5
Chilton	43	−13	17.2	0.30	1.5
Citypoint	39	−19	14.4	0.10	1.0
Delavan	38	−10	16.9	0.80	3.5
Dodgeville	46	−16	15.6	0.39	2.5
Easton	47	−20	13.8	0.46	2.6
Eau Claire	36	−23	11.5	0.27	2.5
Florence†	37	−21	15.6	0.15	1.5
Fond du Lac	42	−12	15.9	0.51	3.7
Grand River Locks	......	......	......	0.39	4.0
Grantsburg†	41	−36	12.3	T.	T.
Gratiot	48	−12	15.4	T.	
Hartford	46	−10	8.3	0.70	3.0
Harvey	43	−11	17.8	0.45	3.4
Hayward	40	−35	12.9	0.06	0.6
Heafford Junction	36	−24	13.5	0.10	1.0
Hillsboro	44	−18	15.7	0.45	1.5
Knapp	41	−25	11.6	T.	T.
Koepenick *†[1]	44	−18	14.5	0.30	3.0
Lancaster†	44	−15	15.4	0.44	4.0
Lincoln	40	− 8	20.4	0.70	7.0
Madison†	42	−12	17.6	0.21	0.9
Manitowoc†	44	− 7	19.2	0.62	5.5
Meadow Valley†	38	−24	12.6	0.23	3.0
Medford†	43	−28	11.8	T.	T.
Wisconsin—Cont'd.	°	°	°	Ins.	Ins.
Menasha	......	......	......	0.59	5.5
Neillsville	38	−22	11.7	0.43	......
New Holstein	34	−10	10.2	0.10	1.0
New London	42	−16	15.6	0.46	6.0
North Crandon	38	−27	15.0	0.28	2.8
Oconto	45	−12	18.8	0.40	4.0
Osceola†	40	−40	7.9	0.07	0.7
Oshkosh	43	−14	17.1	0.46	......
Pepin	36	−22	11.6	0.18	2.0
Pine River†	46[e]	−19[e]	16.8[e]	0.58	5.6
Portage†	43	−15	16.2	0.15	2.0
Port Washington	52	−10	21.2	1.20	1.0
Prairie du Chien	60	−13	23.4	0.40	0.5
Prentice *[1]	41	−26	10.8	0.11	1.1
Racine	51	0	23.0	0.53	......
Sharon	48	−10	17.2	0.46	1.0
Shawano	40	−17	16.3	0.38	4.0
Spooner	38	−32	9.6	0.00	0.0
Stevens Point†	41	−22	13.8	0.50	5.0
Valley Junction†	40	−22	13.6	0.14	1.5
Viroqua	39	−20	15.8	0.97	2.8
Watertown†	44	−12	16.0	0.77	4.0
Waukesha†	46	−10	18.6	0.50	1.8
Waupaca	40	−19	15.8	0.59	4.8
Wausau†	38	−19	14.0	0.39	4.0
Wausaukee	38	−15	17.3	0.30	3.0
Westfield†	43	−18	16.1	0.41	2.1
Whitehall	40	−23	11.6	0.30	3.0
Wyoming.					
Basin	47	−23	11.8	0.10	2.5
Big Horn Ranch	51	−20	23.3	0.20	3.0
Big Piney	38	−30	5.8	0.00	
Binford	......	......	......	1.58	15.8
Carbon	48	−26	17.9	0.23	4.9
Dome Lake	......	......	......	1.70	17.0
Evanston	42	−13	11.9	0.50	5.0
Fort Laramie	57	−19	22.4	0.25	5.0
Fort Washakie	58	−23	18.2	0.29	2.9
Fort Yellowstone	37	−15	17.2	0.67	6.7
Hecla	60	−16	27.0	0.35	4.6
Laramie	45	−22	14.1	0.23	2.3
Lovell	......	−23	......	0.03	0.3
Lusk	55	−20	21.4	0.78	7.8
Rawlins	40	−20	14.0	0.80	8.0
Rock Springs	50	−18	16.0	0.32	3.2
Sheridan	60	−22	19.8	1.35	13.5
Sherman	......	......	......	2.50	25.0
Thayne	42	−25	11.8	0.85	8.5
Wamsutter	45	−26	11.8	0.20	2.0
Wheatland	60	−15	27.6	0.70	7.0
Mexico.					
Ciudad P. Diaz	77	25	48.5	0.96	
Coatzacoalcos [2]	......	......	71.8		
Leon de Aldamas	73	31	56.2	T.	
Puebla	73	33	52.3	0.04	
Tampico [2]	......	......	61.0		
Topolobampo *[1]	80	50	64.1	0.22	
Vera Cruz [2]	......	......	68.9		
New Brunswick.					
St. John	44	− 7	24.5	3.68	27.7
Porto Rico.					
Guayama *[1]	81	66	73.0	......	
Luquillo	84	64	75.2	9.27	
Ponce *[1]	86	66	75.3		
Rio Piedras	86	66	74.4		

Late reports for November, 1898.

Stations.	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Arizona.					
Arizona Canal Co. Dam.	90	29	59.8	0.86	
Dragoon	......	......	......	0.00	
California.					
Azusa	......	......	......	0.10	
Chino	......	......	......	0.09	
Hydesville	......	......	......	5.30	
Mount Frazier	......	......	......	0.05	......
San Miguel Island	81	42	53.8	0.20	
Connecticut.					
North Grosvenor Dale	61	18	42.0	6.36	
Winsted *[1]	57	19	36.8	......	
Idaho.	°	°	°	Ins.	Ins.
Murray	......	......	......	4.75	38.0
Iowa.					
Mount Pleasant	71	− 1	37.4	......	......
Wapello	......	......	......	1.28	5.5
Kansas.					
Hays	77	− 2	37.2	1.10	11.0
Hoxie	67	− 2	35.9	0.35	3.5
Ulysses	......	......	......	0.80	8.0
Massachusetts.					
Lynn (*a*)	60	22	40.0	3.09	......
Minnesota.					
Fergus Falls	60	−13	24.9	0.51	3.6
Lutsen [b]	55	− 4	28.3	1.40	......
Zumbrota [1]	62*	−17	29.2	......	......
Missouri.					
Birchtree	77	10	40.4	2.23	T.
Conception	70[e]	1	39.0[e]	0.85	8.5
Unionville	77	1	40.6	0.40	4.0
Nevada.					
Tuscarora	......	......	......	2.10	26.9
New York.					
Ogdensburg	......	......	......	0.94	5.3
Ohio.					
Bellefontaine	65	8	36.9	......	......
Cedarville	......	......	......	2.23	1.5
Hanging Rock	73	14	42.0	......	......
Texas.					
Anna	......	......	......	1.68	1.0
Washington.					
Tunnel	......	......	......	8.40	84.0
Vashon	55	31	43.8	6.25	T.
Wisconsin.					
Dodgeville	65	− 5	31.2	......	......
Mexico.					
Coatzacoalcos [2]	......	......	76.7	......	......
Tampico [2]	......	......	68.0		
Vera Cruz [2]	......	......	72.2		

EXPLANATION OF SIGNS.

* Extremes of temperature from observed readings of dry thermometer.

† Weather Bureau instruments.

A numeral following the name of a station indicates the hours of observation from which the mean temperature was obtained, thus:

[1] Mean of 7 a. m. + 2 p. m. + 9 p. m. + 9 p. m. ÷ 4.
[2] Mean of 8 a. m. + 8 p. m. ÷ 2.
[3] Mean of 7 a. m. + 7 p. m. ÷ 2.
[4] Mean of 6 a. m. + 6 p. m. ÷ 2.
[5] Mean of 7 a. m. + 2 p. m. ÷ 2.
[6] Mean of readings at various hours reduced to true daily mean by special tables.
[7] Mean from hourly readings of thermograph.
[8] Mean of 7 a. m. + 2 p. m. + 9 p. m. ÷ 3.
[9] Mean of sunrise and noon.
[10] Mean of sunrise, noon, sunset, and midnight.

The absence of a numeral indicates that the mean temperature has been obtained from daily readings of the maximum and minimum thermometers.

An italic letter following the name of a station, as "Livingston *a*," "Livingston *b*," indicates that two or more observers, as the case may be, are reporting from the same station. A small roman letter following the name of a station, or in figure columns, indicates the number of days missing from the record; for instance, "n" denotes 14 days missing.

No note is made of breaks in the continuity of temperature records when the same do not exceed two days. All known breaks, of whatever duration, in the precipitation record receive appropriate notice.

CORRECTIONS.

New Mexico, Fort Bayard, November, 1898, make mean temperature 44.2 instead of 43.6.

Chart X, December, 1898, in Maryland, for 87 read 95.

Page 542 under head of observations at Circle City, Alaska, in heading of absolute mimimum temperature, make 1867 read 1897.

Table No. III will be found on page 591.

TABLE IV.—*Mean temperature for each hour of seventy-fifth meridian time, December, 1898.*

Stations.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	Noon.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Midn't.	Mean.
Bismarck, N. Dak	14.8	14.4	14.1	13.9	13.5	12.5	12.1	12.1	11.5	11.3	13.6	16.8	19.6	21.8	23.7	24.6	24.3	22.2	19.7	18.1	17.2	16.1	15.8	15.0	16.6
Boston, Mass	30.5	30.1	30.0	29.7	29.4	28.8	28.8	29.6	30.4	31.9	33.8	35.1	35.7	36.2	35.9	35.0	34.0	33.0	32.3	31.9	31.5	31.3	30.7	30.5	31.9
Buffalo, N. Y	29.2	29.1	28.8	28.5	28.3	28.1	28.3	28.5	28.9	29.2	29.6	30.0	30.6	30.8	30.8	30.5	30.3	30.0	29.9	30.0	29.6	29.6	29.3	28.7	29.4
Chicago, Ill	23.7	23.2	22.6	22.2	21.8	21.1	20.7	20.9	20.5	21.5	22.8	24.8	25.7	26.7	27.6	28.2	28.2	27.7	26.9	26.1	25.5	24.9	24.4	23.7	24.2
Cincinnati, Ohio	31.0	30.4	29.8	29.6	29.2	29.1	28.9	29.2	29.2	30.3	31.7	33.2	34.7	35.6	36.4	36.4	36.4	35.6	34.4	33.6	32.7	32.2	31.7	31.1	32.2
Cleveland, Ohio	28.1	27.8	27.6	27.5	27.3	27.1	27.1	27.3	27.6	28.4	29.2	29.8	30.5	31.0	31.5	31.5	31.1	30.4	29.9	29.7	29.4	28.8	28.4	28.0	29.0
Detroit, Mich	26.4	26.1	26.0	25.8	25.5	25.5	25.3	25.4	25.5	26.0	26.7	27.4	28.2	28.7	29.0	29.0	28.7	28.5	27.9	27.4	26.8	26.5	26.4	26.2	26.9
Dodge, Kans	24.2	23.0	22.3	21.7	21.4	20.6	20.0	19.7	19.1	20.3	23.9	28.0	31.2	33.5	34.8	35.6	35.9	35.0	31.5	28.0	26.8	25.7	24.7	23.8	26.3
Eastport, Me	26.1	25.8	25.1	24.5	24.0	23.8	23.6	23.8	24.7	25.5	26.4	27.4	28.5	28.8	28.8	28.3	27.9	27.6	27.3	27.3	26.9	26.6	26.4	25.9	26.3
Galveston, Tex	50.2	49.8	49.4	49.0	48.7	48.2	47.9	47.4	46.9	47.5	48.7	50.4	51.7	52.4	53.1	53.7	53.5	52.6	52.0	51.6	51.0	51.0	50.7	50.3	50.3
Havre, Mont	21.9	21.5	20.8	20.9	20.8	19.6	19.5	19.9	19.4	18.8	19.2	21.0	23.2	25.6	26.6	27.5	27.7	26.6	24.4	22.8	21.5	21.0	21.0	21.3	22.2
Kansas City, Mo	26.5	25.8	25.1	24.7	24.4	24.0	23.5	23.6	23.2	23.8	25.5	27.6	29.3	30.9	32.0	32.5	32.5	31.5	30.5	29.7	29.0	28.2	27.3	26.5	27.4
Key West, Fla	68.6	68.5	68.5	68.2	68.3	68.2	67.9	68.3	69.4	70.9	71.5	72.7	72.6	72.8	72.8	72.4	71.5	70.5	70.0	70.0	69.5	69.1	69.1	69.0	70.0
Memphis, Tenn	40.0	39.2	38.4	37.7	37.1	36.6	36.4	36.6	36.7	38.2	40.6	41.8	43.2	44.5	45.7	46.1	45.9	45.2	43.9	43.5	42.2	41.6	40.8	39.9	40.9
Mt. Tamalpais, Cal	45.8	45.7	45.1	44.7	44.2	44.5	44.0	43.8	43.6	43.5	44.1	44.2	45.4	46.0	47.1	47.9	48.0	47.6	46.9	46.2	46.3	45.9	45.7	45.4	45.5
New Orleans, La	48.8	48.2	47.5	47.2	46.7	46.6	46.7	46.3	46.5	47.4	49.2	51.5	53.1	54.3	55.7	56.2	56.1	54.9	53.5	52.0	50.8	49.7	48.9	48.3	50.3
New York, N. Y	33.2	32.6	32.5	32.2	32.0	31.6	31.6	32.1	32.5	33.7	34.8	36.0	36.5	37.3	37.5	36.8	36.6	36.0	35.5	35.3	34.3	34.3	33.9	33.0	34.3
Philadelphia, Pa	34.6	34.3	33.8	33.5	33.1	32.7	32.5	32.6	33.1	34.7	36.1	37.5	38.7	39.6	39.9	39.5	38.7	37.8	37.0	36.4	35.8	35.1	34.8	34.5	35.7
Pittsburg, Pa	31.7	31.3	31.1	31.2	30.9	30.5	30.5	30.9	31.3	32.5	33.6	34.9	35.6	36.8	36.7	36.4	35.5	34.5	33.5	33.6	32.9	32.6	31.8	31.3	33.0
Portland, Oreg	36.5	36.4	36.5	36.7	36.3	35.8	35.6	35.7	35.1	34.5	33.9	34.5	35.6	36.8	38.1	39.2	39.9	39.9	39.7	38.9	38.1	37.6	37.1	36.6	36.9
St. Louis, Mo	31.3	30.3	30.1	29.4	29.0	28.1	27.8	27.3	27.1	27.7	29.7	31.0	32.9	34.6	36.0	36.9	36.7	35.9	35.0	34.4	33.9	33.2	32.4	31.6	31.8
St. Paul, Minn	12.5	11.6	10.5	10.1	9.5	9.4	9.2	9.3	9.3	9.8	11.0	13.2	15.3	17.0	18.1	19.0	19.1	18.3	17.1	15.9	15.1	14.3	13.4	12.7	13.4
Salt Lake City, Utah	23.6	23.2	22.3	21.8	21.0	20.4	20.6	21.4	20.0	19.7	21.3	24.2	26.9	29.0	30.5	31.3	31.0	30.5	28.5	27.5	27.0	26.2	25.4	24.8	24.9
San Diego, Cal	53.9	53.5	53.3	52.9	52.7	52.4	52.2	51.5	51.2	51.1	52.7	55.9	59.2	61.0	62.4	63.0	62.8	61.9	60.6	58.8	57.7	56.4	54.8	54.4	56.1
San Francisco, Cal	49.2	48.8	48.4	47.8	47.5	46.9	46.7	46.8	45.9	45.9	45.6	46.3	47.5	48.9	50.5	52.2	53.5	54.4	54.3	53.6	52.4	51.6	50.5	49.9	49.4
Savannah, Ga	48.2	47.8	47.3	46.6	46.3	46.2	45.9	46.4	48.0	50.7	53.5	55.4	56.8	57.7	57.9	57.3	55.5	53.4	52.1	51.5	50.6	50.1	49.7	49.3	51.0
Washington, D. C	32.8	32.5	31.8	31.8	30.8	30.8	30.5	30.9	32.5	34.7	37.1	38.8	40.1	41.3	41.7	42.0	41.5	39.6	37.9	36.8	35.5	34.8	34.1	33.3	35.6
West Indies.																									
Basseterre, St. Kitts	74.2	74.7	74.5	74.6	74.5	74.6	75.5	77.1	78.1	79.6	81.0	81.3	81.1	80.7	80.2	78.7	77.4	76.6	76.3	76.1	76.0	75.7	75.7	75.2	77.0
Bridgetown, Bar	74.0	73.6	73.4	73.4	73.4	74.8	77.6	79.9	81.2	82.2	82.6	82.5	82.1	81.5	80.7	79.1	77.4	76.4	75.6	75.1	74.8	74.7	74.4	74.1	77.3
Colon, U. S. C	77.5	77.2	76.7	76.4	76.4	76.4	76.2	77.3	79.2	81.0	81.9	83.1	83.2	83.5	82.8	82.2	81.3	79.9	79.2	79.2	78.8	78.6	78.2	77.9	79.3
Kingston, Jamaica	70.1	69.6	69.6	69.3	69.5	69.0	68.6	71.3	77.0	80.9	82.4	83.2	83.2	83.0	82.2	81.1	79.4	76.4	74.6	73.3	72.2	71.3	70.8	70.5	74.9
Port of Spain, Trin	72.3	72.2	71.9	71.7	71.8	73.1	76.3	79.0	80.7	82.2	83.5	84.0	83.1	82.1	81.4	79.9	78.3	76.6	75.5	74.9	74.5	74.1	73.3	72.7	76.9
Roseau, Dominica	73.5	73.3	73.2	73.4	73.6	73.6	77.6	80.3	81.5	82.1	82.6	82.5	82.8	82.5	82.3	79.7	77.4	76.2	75.4	75.0	74.8	74.6	74.3	73.9	77.3
San Juan, P. R	73.1	72.7	72.5	72.5	72.4	72.3	73.0	74.7	77.2	79.7	80.3	80.8	80.6	80.5	79.7	78.7	77.5	76.1	75.5	75.1	74.6	74.3	73.8	73.4	75.9
Santiago de Cuba	71.3	70.9	70.3	70.1	69.9	69.8	70.0	73.5	76.6	80.5	82.8	84.5	85.0	84.5	83.5	82.0	80.0	77.6	75.8	74.5	73.7	73.0	72.2	71.7	76.0
Santo Domingo, S. D.	68.7	68.0	67.8	67.5	67.3	67.2	68.3	72.3	76.3	79.2	80.4	81.2	80.4	79.9	79.7	78.6	77.2	75.5	73.8	72.4	71.2	70.4	69.9	69.2	73.4
Willemstad, Curaçao	76.0	75.6	75.4	75.4	75.2	75.7	77.4	78.7	80.1	81.3	82.0	81.6	81.7	81.4	80.6	79.6	78.1	77.4	77.0	76.9	76.8	76.6	76.2	76.1	78.0

TABLE V.—*Mean pressure for each hour of seventy-fifth meridian time, December, 1898.*

Stations.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	Noon.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Midn't.	Mean.
Bismarck, N. Dak	28.255	.255	.257	.266	.271	.271	.270	.272	.271	.273	.278	.283	.270	.257	.246	.244	.248	.259	.267	.273	.276	.275	.273	.272	.266
Boston, Mass	29.827	.831	.830	.829	.831	.845	.856	.871	.882	.880	.863	.846	.837	.838	.845	.852	.858	.865	.870	.865	.867	.862	.860	.853	.853
Buffalo, N. Y	29.092	.096	.103	.100	.098	.105	.114	.118	.130	.142	.140	.124	.114	.108	.111	.115	.120	.124	.131	.129	.131	.128	.125	.119	.117
Chicago, Ill	29.137	.137	.150	.150	.145	.147	.154	.168	.170	.181	.180	.165	.147	.129	.122	.130	.138	.146	.153	.157	.165	.166	.168	.168	.153
Cincinnati, Ohio	29.436	.435	.440	.440	.435	.434	.441	.448	.456	.468	.469	.444	.423	.411	.412	.413	.422	.433	.444	.451	.457	.461	.463	.462	.442
Cleveland, Ohio	29.172	.178	.185	.180	.182	.184	.189	.193	.211	.220	.207	.189	.172	.165	.165	.169	.173	.178	.183	.185	.190	.194	.195	.196	.186
Detroit, Mich	29.189	.192	.200	.200	.198	.200	.205	.213	.224	.236	.238	.225	.206	.195	.190	.193	.201	.204	.207	.209	.213	.214	.217	.219	.208
Dodge, Kans	27.518	.514	.515	.523	.524	.518	.519	.530	.527	.534	.545	.542	.523	.498	.483	.475	.477	.485	.493	.511	.519	.526	.532	.535	.515
Eastport, Me	29.803	.810	.813	.811	.811	.817	.826	.837	.853	.858	.844	.830	.821	.819	.825	.831	.838	.844	.852	.855	.854	.853	.845	.841	.833
Galveston, Tex	30.139	.134	.132	.131	.130	.134	.144	.153	.172	.187	.195	.185	.156	.130	.115	.104	.104	.106	.121	.132	.143	.152	.161	.165	.143
Havre, Mont	27.396	.394	.393	.395	.402	.400	.399	.400	.404	.410	.422	.433	.425	.411	.399	.395	.396	.397	.397	.396	.402	.405	.407	.411	.404
Kansas City, Mo	29.135	.129	.129	.134	.134	.133	.132	.135	.143	.154	.168	.170	.158	.136	.120	.116	.119	.121	.128	.136	.140	.144	.148	.156	.138
Key West, Fla	30.115	.108	.104	.101	.099	.104	.118	.138	.151	.163	.154	.145	.121	.099	.090	.088	.090	.095	.104	.124	.126	.128	.127	.124	.117
Memphis, Tenn	29.746	.747	.751	.754	.755	.754	.762	.773	.784	.797	.809	.801	.776	.759	.746	.746	.750	.753	.761	.767	.768	.770	.774	.773	.766
Mt. Tamalpais, Cal	27.715	.716	.710	.708	.709	.712	.704	.700	.702	.707	.717	.731	.740	.735	.712	.696	.686	.685	.686	.686	.692	.696	.703	.703	.706
New Orleans, La	30.144	.140	.141	.140	.140	.144	.151	.160	.176	.193	.193	.180	.151	.127	.117	.113	.114	.120	.132	142	.156	.164	.167	.165	.149
New York, N. Y	29.672	.679	.686	.683	.683	.693	.707	.716	.726	.730	.713	.694	.679	.675	.678	.683	.691	.696	.699	.704	.705	.703	.696	.690	.695
Philadelphia, Pa	29.924	.934	.938	.935	.937	.947	.955	.968	.982	.988	.977	.958	.937	.928	.928	.930	.930	.932	.935	.940	.944	.947	.941	.938	.945
Pittsburg, Pa	29.135	.137	.137	.138	.137	.143	.150	.162	.159	.161	.168	.163	.148	.142	.130	.132	.131	.134	.143	.154	.155	.156	.155	.154	.147
Portland, Oreg	30.107	.109	.108	.105	.109	.113	.107	.097	.090	.092	.100	.115	.123	.124	.115	.101	.090	.085	.087	.088	.084	.085	.089	.091	.101
St. Louis, Mo	29.521	.519	.522	.524	.521	.525	.533	.547	.557	.572	.579	.567	.547	.527	.521	.522	.525	.527	.532	.537	.543	.543	.547	.545	.538
St. Paul, Minn	29.123	.123	.125	.131	.128	.123	.121	.120	.124	.137	.147	.150	.134	.119	.111	.115	.122	.128	.134	.140	.144	.146	.147	.152	.131
Salt Lake City, Utah	25.857	.856	.855	.857	.865	.860	.856	.856	.865	.874	.880	.892	.887	.869	.848	.838	.828	.839	.839	.843	.843	.840	.845	.849	.856
San Diego, Cal	30.020	.019	.015	.012	.012	.007	.001	.000	.008	.020	.035	.053	.059	.042	.014	.991	.980	.981	.985	.990	.998	.010	.016	.021	.012
San Francisco, Cal	30.082	.083	.082	.082	.086	.087	.081	.080	.084	.090	.100	.114	.118	.100	.075	.057	.047	.044	.043	.044	.050	.056	.065	.074	.076
Savannah, Ga	30.089	.088	.090	.087	.087	.094	.106	.115	.127	.133	.126	.102	.081	.067	.061	.064	.071	.079	.085	.092	.096	.098	.098	.093	.093
Washington, D. C	29.965	.972	.976	.972	.974	.979	.994	.004	.015	.022	.011	.986	.966	.956	.955	.956	.959	.964	.974	.982	.984	.985	.984	.977	.980
West Indies.																									
Basseterre, St. Kitts	30.032	.021	.018	.021	.031	.035	.054	.069	.077	.068	.054	.032	.018	.011	.009	.019	.026	.025	.039	.051	.056	.057	.049	.039	.038
Bridgetown, Bar	29.971	.960	.958	.962	.972	.988	.010	.022	.025	.020	.003	.980	.962	.955	.956	.960	.967	.976	.990	.998	.001	.999	.995	.984	.984
Colon, U. S. C	29.912	.902	.889	.887	.890	.898	.922	.937	.951	.953	.944	.931	.904	.885	.862	.857	.864	.873	.886	.901	.919	.927	.928	.925	.906
Kingston, Jamaica	29.746	.735	.723	.720	.724	.730	.752	.772	.785	.785	.771	.751	.720	.698	.691	.692	.702	.714	.734	.753	.765	.768	.766	.757	.740
Port of Spain, Trin	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Roseau, Dominica	29.988	.983	.980	.982	.992	.014	.028	.037	.042	.033	.006	.987	.970	.964	.965	.970	.979	.996	.004	.010	.012	.010	.006	.998	.998
San Juan, P. R	29.979	.970	.966	.970	.982	.994	.011	.022	.027	.023	.006	.986	.965	.956	.955	.961	.970	.979	.992	.002	.005	.002	.996	.987	.988
Santiago de Cuba*	29.961	.947	.941	.940	.946	.956	.972	.989	.100	.100	.985	.957	.912	.912	.911	.915	.924	.937	.951	.969	.982	.983	.978	.973	.956
Santo Domingo, S. D.	30.029	.016	.009	.009	.015	.029	.050	.070	.081	.079	.060	.034	.006	.987	.978	.981	.990	.003	.019	.034	.044	.049	.045	.037	.027
Willemstad, Curaçao	29.901	.888	.885	.888	.900	.916	.943	.957	.963	.954	.933	.910	.885	.867	.860	.863	.871	.881	.900	.915	.927	.929	.925	.916	.907

*For thirty days.

TABLE VI.—*Average wind movement for each hour of seventy-fifth meridian time, December, 1898.*

Stations.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	Noon.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Midnight.	Mean.
Abilene, Tex	8.7	9.3	9.3	9.2	9.1	9.3	8.9	8.6	9.0	9.5	10.7	11.5	12.9	12.7	12.4	12.7	12.4	10.9	9.3	7.5	7.7	8.0	8.6	9.3	9.9
Albany, N. Y	7.1	6.4	6.9	7.0	6.7	7.1	7.0	8.0	9.2	9.1	9.5	9.6	10.2	9.5	9.1	8.0	7.5	6.7	6.7	7.4	7.6	7.5	6.7	7.0	7.8
Alpena, Mich	9.5	9.2	9.4	9.3	9.7	9.7	9.9	9.8	9.6	10.9	11.1	12.0	13.1	12.9	12.7	11.9	11.0	10.4	10.9	10.4	10.1	9.8	9.5	9.3	10.5
Amarillo, Tex	16.0	15.9	15.3	16.5	15.6	15.3	15.4	14.8	14.4	13.1	14.0	14.2	15.2	15.0	15.0	14.7	14.7	13.7	12.8	12.5	13.6	14.6	14.8	15.0	14.7
Atlanta, Ga	9.7	10.2	9.8	10.0	9.8	9.1	9.4	9.0	9.1	9.4	9.5	10.0	10.5	11.0	11.0	10.6	9.9	8.8	8.6	9.2	9.5	10.0	10.5	10.6	9.8
Atlantic City, N. J	10.2	10.3	10.2	10.6	11.2	10.4	11.0	10.8	12.5	13.1	13.6	14.3	14.4	14.5	13.8	12.7	11.2	10.3	10.9	11.0	10.6	10.8	11.1	10.7	11.7
Augusta, Ga	4.9	4.9	4.8	5.4	4.8	5.0	4.7	5.5	5.8	6.7	7.1	7.9	8.5	8.7	9.0	9.4	8.3	6.5	5.5	5.3	5.0	4.8	4.7	5.5	6.2
Baker City, Oreg	4.8	4.7	5.8	6.0	5.3	5.5	5.0	4.9	4.9	5.2	4.9	5.3	4.7	4.9	4.2	3.5	4.0	3.6	2.8	2.8	3.7	4.5	5.3	5.3	4.7
Baltimore, Md	4.5	4.5	4.6	4.9	5.0	4.8	4.3	4.3	5.1	6.4	7.2	8.0	7.8	7.9	7.7	7.0	6.3	5.4	4.8	4.9	4.7	4.8	4.9	5.0	5.6
Bismarck, N. Dak	7.7	7.5	7.4	7.1	7.1	7.6	7.8	7.5	7.8	8.8	9.4	11.1	12.6	14.2	14.4	14.2	13.7	11.9	9.5	8.5	8.5	8.8	7.5	7.7	9.5
Block Island, R. I	18.3	17.5	17.0	16.8	16.6	17.0	17.4	17.0	17.5	17.9	18.7	19.6	20.1	19.2	19.0	19.2	18.7	19.5	19.4	19.6	18.8	19.7	18.9	18.4	18.4
Boise, Idaho	3.5	3.1	3.1	2.9	2.8	3.0	2.6	2.7	2.8	2.6	2.9	2.8	3.9	3.8	4.3	4.1	4.7	4.4	4.2	3.4	3.5	3.9	4.3	3.6	3.5
Boston, Mass	11.0	11.2	11.0	10.5	10.2	10.5	11.2	11.3	12.2	11.7	12.4	13.5	13.5	13.6	13.5	13.2	11.8	11.4	11.7	11.4	12.1	12.1	12.2	11.8	11.9
Buffalo, N. Y	25.0	24.9	24.9	25.4	25.3	24.4	23.0	22.5	22.1	21.9	23.5	24.1	24.9	24.5	24.3	23.5	24.2	24.0	25.6	25.6	24.6	23.6	23.7	23.2	24.1
Cairo, Ill	9.2	9.4	9.9	9.5	9.7	9.4	9.5	9.7	9.2	9.9	10.5	11.3	11.0	11.5	11.5	11.0	11.3	9.4	9.3	9.5	9.6	9.5	9.6	9.6	10.0
Cape Henry, Va	12.6	12.9	12.5	12.5	12.3	12.2	12.4	12.1	12.9	14.0	14.3	14.2	14.4	13.9	12.7	12.3	10.9	10.7	11.5	12.1	11.7	11.8	13.1	14.0	12.7
Carson City, Nev	4.4	3.5	3.3	2.9	3.0	3.3	4.3	4.1	3.4	2.8	3.0	2.6	3.9	5.0	6.0	6.9	7.5	8.7	8.5	7.3	5.2	4.9	4.2	4.6	4.7
Charleston, S. C	9.6	9.6	9.6	9.2	9.5	9.5	10.2	10.2	10.5	10.5	10.6	10.7	12.1	11.4	11.1	10.6	9.8	9.2	9.4	9.5	9.8	9.5	8.8	9.0	10.0
Charlotte, N. C	7.2	6.8	6.4	6.1	6.0	5.7	6.0	6.3	6.7	7.5	8.0	8.3	9.2	9.1	9.5	9.7	8.5	7.8	7.7	7.1	7.8	7.8	7.2	6.9	7.5
Chattanooga, Tenn	6.8	6.9	6.3	6.4	6.2	6.5	6.4	5.5	6.4	6.8	7.1	7.5	8.2	8.7	9.6	10.6	9.7	8.9	7.8	7.2	8.4	7.5	7.3	7.2	7.5
Cheyenne, Wyo	11.3	11.4	11.2	11.0	11.9	13.7	14.2	14.5	13.6	13.4	13.8	13.7	16.5	16.4	16.9	17.2	16.7	13.8	12.1	10.4	10.6	10.8	10.5	11.0	13.2
Chicago, Ill	18.6	18.1	18.3	18.1	18.1	18.0	17.9	19.0	19.1	19.1	19.6	20.9	22.8	23.1	23.9	23.1	22.3	20.8	21.1	20.8	19.8	19.3	18.3	17.8	19.9
Cincinnati, Ohio	8.8	8.3	7.6	7.8	7.9	8.2	8.1	8.3	9.0	9.8	10.7	10.3	10.9	11.4	11.3	11.2	10.9	10.3	10.3	10.1	9.3	8.7	8.7	8.4	9.4
Cleveland, Ohio	18.7	18.4	18.3	17.6	17.6	18.0	17.5	18.1	18.3	18.1	18.2	18.1	18.4	18.1	18.4	18.0	18.1	18.6	19.3	20.8	20.9	21.5	20.7	20.2	18.8
Columbia, Mo	8.7	9.5	9.1	9.7	9.4	8.9	9.1	9.0	9.3	9.2	10.2	11.0	11.6	12.3	12.3	11.8	11.1	9.6	9.0	9.4	8.9	9.0	8.5	8.7	9.8
Columbus, Ohio	9.1	9.1	9.1	8.6	8.7	8.7	8.7	8.6	8.9	9.9	10.3	10.9	11.4	11.5	11.5	10.8	10.1	9.2	9.3	9.8	10.0	9.5	9.2	9.1	9.7
Concordia, Kans	5.8	5.6	5.9	5.8	5.8	5.7	5.4	5.0	5.4	6.0	6.9	7.5	7.1	7.5	7.1	7.2	6.7	5.9	4.9	5.8	6.0	6.1	6.1	5.8	6.1
Corpus Christi, Tex	9.7	9.5	9.3	9.2	8.9	9.5	9.6	10.4	9.7	9.7	10.8	10.7	10.6	10.7	10.8	11.1	11.6	12.2	11.1	9.9	9.7	9.8	10.1	10.0	10.2
Davenport, Iowa	7.6	7.2	7.1	7.1	7.4	7.7	7.7	8.1	8.1	8.6	9.6	10.7	11.3	11.5	11.5	11.3	10.3	9.3	8.6	8.1	7.6	7.8	7.5	7.4	8.7
Denver, Colo	8.9	9.4	8.7	8.0	8.7	8.3	8.7	9.1	8.4	8.3	8.9	7.8	8.4	7.6	7.6	7.3	7.7	7.9	7.3	7.4	8.0	7.7	7.8	8.3	8.2
Des Moines, Iowa	7.7	7.5	7.1	6.9	7.2	7.3	7.5	7.4	7.4	7.7	8.3	8.4	9.0	9.1	9.4	8.8	8.2	7.5	7.1	6.4	6.9	6.8	7.4	7.6	7.7
Detroit, Mich	13.8	13.2	12.6	12.6	12.6	12.7	12.5	12.4	12.2	13.5	13.6	13.7	14.5	14.5	14.9	14.6	13.9	13.8	13.3	14.4	14.1	14.0	14.4	14.2	13.6
Dodge, Kans	8.9	9.0	9.3	9.0	9.8	9.7	9.6	9.7	9.5	9.3	9.4	10.1	11.3	10.9	10.9	10.8	9.5	8.1	6.7	7.6	7.3	8.3	8.1	8.4	9.2
Dubuque, Iowa	6.7	6.5	6.0	6.3	6.6	6.6	6.3	6.8	6.8	7.5	8.4	9.1	9.7	9.5	9.7	9.9	8.8	8.1	7.3	6.9	6.8	6.7	7.3	6.6	7.5
Duluth, Minn	9.7	9.3	8.6	7.3	8.2	8.7	8.4	9.2	9.0	8.9	10.6	9.2	9.5	9.7	9.9	9.8	8.8	8.5	8.4	9.4	9.3	9.7	9.8	10.3	9.2
Eastport, Me	11.7	11.4	11.9	12.2	12.3	11.8	12.6	12.6	12.2	11.2	11.8	11.9	11.6	12.1	11.8	10.9	10.6	10.0	10.9	10.9	11.5	11.4	11.4	11.7	11.6
El Paso, Tex	11.3	12.1	12.3	12.7	12.1	10.5	10.0	10.5	11.6	12.1	10.8	10.8	12.3	12.6	13.5	14.1	14.6	14.2	14.1	12.2	12.7	13.4	13.1	11.5	12.3
Erie, Pa	16.6	15.8	15.8	16.2	16.4	15.9	16.0	16.0	15.9	16.1	15.9	15.5	15.5	15.4	15.7	15.5	15.1	15.6	15.1	16.0	17.2	17.0	17.4	17.1	16.0
Escanaba, Mich	8.5	9.0	8.8	8.8	9.4	9.4	9.3	9.5	9.5	9.3	10.1	10.6	10.0	10.0	10.1	10.1	9.0	8.1	8.3	8.5	8.4	8.4	8.4	8.3	9.1
Eureka, Cal	3.3	2.8	2.7	3.2	2.9	3.0	2.8	3.1	3.1	2.8	3.3	3.1	3.2	3.9	4.3	5.1	5.4	6.0	5.8	4.9	5.3	5.1	4.7	4.5	3.9
Evansville, Ind	7.5	7.7	7.7	7.9	7.5	7.9	7.9	7.9	8.1	8.6	8.6	9.4	9.7	9.9	10.4	10.7	9.3	8.7	8.3	8.2	8.9	8.4	8.0	7.6	8.5
Fort Canby, Wash	14.5	14.7	15.5	15.2	15.8	15.2	16.0	15.6	16.1	16.1	16.7	17.3	17.7	18.8	18.4	18.3	18.4	17.7	18.6	17.3	15.7	15.4	16.2	15.7	16.5
Fort Smith, Ark	6.1	6.3	6.2	6.7	6.6	6.5	6.5	6.8	6.6	7.5	7.5	8.0	8.6	8.7	8.6	8.8	8.8	8.0	7.3	6.5	5.6	5.8	6.0	6.0	7.1
Fresno, Cal	3.3	3.2	3.5	3.7	4.1	3.9	3.9	3.7	3.7	3.3	3.0	2.7	3.6	3.7	3.5	3.6	3.5	3.5	3.5	2.9	2.9	3.0	3.5	3.4	3.4
Galveston, Tex	11.1	10.9	11.2	11.1	11.0	11.0	11.0	10.8	10.5	11.2	11.2	11.1	11.8	11.8	11.5	11.6	11.7	10.5	10.5	10.7	11.0	11.5	11.8	11.7	11.2
Grand Haven, Mich	13.6	13.2	12.9	13.1	12.9	13.4	13.3	13.0	13.3	13.3	13.9	14.4	14.8	14.4	14.2	14.1	13.6	13.7	14.0	13.6	13.2	13.6	13.1	12.8	13.6
Green Bay, Wis	8.3	8.8	8.2	7.7	7.7	7.8	7.9	8.5	8.3	8.2	9.4	9.8	10.4	10.4	10.3	10.0	9.4	8.4	8.6	8.5	8.5	8.1	7.5	7.9	8.7
Hannibal, Mo	16 3	10.2	10.3	10.4	9.9	10.1	10.1	10.0	10.3	11.2	12.2	12.7	14.1	13.3	13.6	13.4	11.8	10.0	9.6	9.1	10.2	10.4	10.1	9.6	10.9
Harrisburg, Pa	7.7	6.8	7.1	7.6	7.9	7.3	7.9	7.9	8.4	9.9	10.4	10.7	11.6	12.0	11.9	11.2	9.3	8.5	7.6	7.2	7.9	7.5	7.9	8.3	8.8
Hatteras, N. C	12.8	13.1	13.3	13.1	13.1	13.3	13.1	13.5	13.6	13.6	13.6	13.3	13.2	13.8	13.8	13.4	13.2	13.0	12.9	13.2	13.9	13.6	13.9	13.6	13.4
Havre, Mont	12.8	13.4	14.1	13.4	14.5	13.8	12.8	13.6	13.9	13.5	12.1	12.3	13.8	15.0	15.4	14.3	14.3	12.4	11.2	11.6	11.6	10.9	11.6	12.3	13.1
Helena, Mont	8.5	7.8	7.2	7.1	7.8	6.8	6.9	7.7	7.5	6.9	8.0	7.8	8.5	7.5	7.1	7.7	7.3	6.7	6.2	7.2	7.9	8.3	9.1	8.4	7.6
Huron, S. Dak	9.9	10.2	10.8	10.7	10.1	9.5	9.3	8.7	8.2	8.2	8.9	11.0	12.6	13.0	14.0	14.1	13.1	11.5	9.6	10.6	10.9	11.2	10.9	10.9	10.7
Idaho Falls, Idaho	8.0	8.2	7.5	6.6	6.2	6.6	6.3	6.5	7.4	7.7	8.4	8.7	8.4	8.3	8.1	8.3	8.3	8.2	7.8	7.8	7.8	8.3	8.7	8.0	7.8
Independence, Cal	8.0	8.7	7.9	8.0	7.9	8.7	8.6	8.9	8.4	8.5	9.0	8.7	9.0	9.7	9.8	9.4	9.1	8.8	8.0	7.4	6.8	6.1	5.7	7.3	8.3
Indianapolis, Ind	11.6	11.8	11.9	11.5	12.2	11.5	11.0	10.7	11.5	12.3	13.2	13.5	14.5	14.9	15.5	15.7	14.9	14.1	14.0	13.3	12.9	12.4	12.5	12.2	12.9
Jacksonville, Fla	6.6	6.7	6.4	6.1	6.5	6.8	7.0	6.6	6.8	8.4	8.8	9.2	8.9	9.5	9.5	9.3	8.5	7.0	6.9	6.3	6.6	7.0	6.9	6.9	7.5
Jupiter, Fla	9.4	9.5	9.3	9.1	9.8	9.5	9.3	9.1	9.6	11.1	11.9	12.5	12.7	13.5	13.6	12.8	11.5	9.6	8.4	8.5	9.5	9.6	9.4	9.1	10.3
Kansas City, Mo	9.6	10.1	10.0	9.4	9.6	9.1	9.0	9.2	9.2	9.6	9.9	10.2	11.2	10.9	11.0	10.5	10.6	9.7	8.5	8.6	9.2	9.5	9.0	9.3	9.7
Keokuk, Iowa	8.2	8.3	8.7	8.8	8.6	8.5	8.9	8.8	9.0	9.7	10.2	10.7	11.6	11.7	11.6	11.4	10.8	9.2	8.6	9.2	9.1	8.2	8.2	7.7	9.4
Key West, Fla	10.7	10.2	10.3	10.5	10.7	10.6	10.7	10.6	11.3	11.7	11.8	11.9	12.0	11.8	11.9	11.7	11.1	10.2	10.8	10.4	11.0	11.3	10.9	10.3	11.0
Kittyhawk, N. C	11.9	12.4	13.2	13.7	13.2	13.0	13.5	13.7	14.0	15.2	15.9	15.3	15.7	15.6	15.1	14.0	12.7	12.3	12.2	12.4	12.1	11.8	12.1	12.5	13.5
Knoxville, Tenn	7.7	7.8	7.1	7.3	8.0	7.5	7.7	7.0	6.9	7.6	8.8	9.3	10.0	10.4	10.4	10.3	10.3	9.2	8.5	7.9	8.1	9.3	8.8	8.1	8.5
La Crosse, Wis	5.1	5.7	6.1	6.4	6.3	6.4	6.3	6.4	6.9	6.5	6.8	7.7	7.7	7.7	7.8	7.7	7.5	6.4	5.9	5.8	5.5	5.7	5.6	4.8	6.4
Lander, Wyo	3.0	2.6	2.6	2.6	2.2	2.3	2.6	2.4	2.5	2.4	2.6	3.1	3.5	4.3	5.5	5.8	4.9	4.7	4.0	4.1	3.6	3.0	3.2	2.9	3.4
Lexington, Ky	13.4	12.6	12.4	12.2	12.0	12.4	12.5	12.6	11.8	12.5	13.1	14.5	14.3	14.0	14.8	13.6	12.5	12.1	12.7	12.8	13.1	13.6	13.4	13.1	13.0
Little Rock, Ark	8.3	8.6	8.4	7.7	7.6	7.6	7.5	7.8	8.5	9.0	9.4	9.9	10.6	10.5	10.9	10.9	10.5	9.6	8.3	7.8	8.5	8.4	8.2	8.4	8.9
Los Angeles, Cal	3.3	3.5	3.9	3.9	4.1	3.9	3.6	3.6	3.6	3.5	3.6	3.6	4.0	4.3	4.7	4.8	4.6	5.3	6.0	4.9	3.7	3.5	3.4	3.6	4.0
Louisville, Ky	8.4	9.1	9.2	9.3	8.7	8.3	8.4	8.2	8.3	9.4	9.9	10.1	10.9	11.0	11.7	11.9	11.5	10.7	9.7	9.1	9.5	9.6	9.2	8.3	9.6
Lynchburg, Va	3.1	3.6	4.0	3.6	3.5	3.5	3.7	3.2	4.1	4.9	5.0	6.3	6.1	6.0	6.1	5.9	5.5	4.7	4.5	3.9	3.6	3.3	3.4	3.2	4.4
Marquette, Mich	10.7	10.7	10.5	10.8	11.1	12.0	10.8	10.4	11.9	12.7	12.6	12.7	11.8	11.8	11.3	10.6	10.2	9.4	9.6	10.2	10.7	11.2	11.0	11.0	11.1
Memphis, Tenn	11.3	11.0	11.5	11.5	11.2	10.5	11.0	10.8	10.5	11.2	11.5	11.3	11.3	12.0	12.1	12.1	11.9	11.1	9.6	9.6	10.3	11.0	11.6	11.4	11.1
Milwaukee, Wis	11.5	11.5	11.3	11.9	11.8	11.3	11.4	11.9	12.0	13.0	13.6	13.6	14.2	14.5	14.7	14.3	14.3	12.5	11.8	12.3	12.0	11.7	11.7	11.1	12.5
Minneapolis, Minn	10.5	10.2	10.0	9.9	10.9	10.8	10.5	9.9	9.6	9.1	9.7	9.7	10.3	9.7	10.1	10.8	10.7	9.6	9.8	10.3	10.7	10.9	10.7	10.3	10.2
Mobile, Ala	7.3	7.0	6.9	7.3	7.3	7.0	7.4	7.1	6.9	7.9	8.5	8.5	8.9	9.1	9.0	9.4	9.2	8.8	7.8	7.8	8.0	8.0	8.6	8.4	8.0
Montgomery, Ala	7.3	7.5	7.0	6.7	6.2	5.6	5.2	5.6	5.9	6.0	7.3	7.5	7.9	8.4	8.7	8.5	7.8	6.3	6.5	6.5	7.1	7.4	7.7	7.7	7.0
Moorhead, Minn	9.3	9.4	9.2	9.6	9.7	9.4	9.6	9.4	9.9	10.1	10.1	10.0	11.3	11.5	11.6	12.3	11.3	9.9	9.8	10.1	9.5	10.0	10.1	9.7	10.1
Mount Tamalpais, Cal	23.0	22.6	22.9	24.0	24.0	23.6	24.7	24.6	24.5	24.3	23.3	21.6	20.2	18.6	17.3	16.4	16.9	18.1	18.9	19.6	20.4	21.1	20.6	21.5	21.4
Nantucket, Mass	12.7	12.4	11.4	10.5	11.0	11.0	10.7	11.4	12.0	12.5	13.7	14.2	14.7	14.5	13.6	12.6	12.7	12.7	12.4	13.0	12.8	13.0	13.2	13.5	12.6
Nashville, Tenn	5.9	5.6	5.0	5.0	5.1	6.0	5.9	6.2	6.4	7.4	7.9	8.1	8.6	9.0	9.0	9.1	9.2	8.2	7.5	7.1	6.8	5.9	6.2	6.4	7.0
Neah, Wash	8.6	9.0	9.2	9.5	9.4	9.0	8.8	9.6	9.7	10.5	10.0	10.4	10.4	10.5	11.2	11.7	11.1	10.3	9.6	8.9	8.6	9.2	8.9	8.4	9.7
New Haven, Conn	8.2	7.4	7.6	7.5	7.3	7.5	8.2	8.3	8.9	9.9	10.9	11.5	12.8	12.4	11.7	11.4	9.8	9.0	8.6	9.2	8.7	8.7	8.7	8.3	9.3
New Orleans, La	8.3	8.6	9.3	9.3	9.3	9.6	9.9	9.9	10.0	10.4	11.0	10.6	11.3	10.8	11.0	10.8	10.5	9.9	8.7	9.4	9.5	9.2	9.1	8.6	9.8
New York, N. Y	15.5	15.1	14.9	15.5	15.8	16.5	15.6	15.3	16.1	17.5	18.5	19.4	19.7	19.6	19.5	18.5	17.5	15.9	15.7	16.4	16.1	16.4	16.4	15.0	16.8
Norfolk, Va	8.3	7.8	7.8	7.7	7.9	7.5	7.3	7.1	8.3	8.6	9.5	9.1	10.2	10.0	9.5	8.8	8.2	7.6	8.2	7.7	8.1	8.1	8.5	8.3	8.3

TABLE VI.—*Average wind movement, etc.*—Continued.

Stations.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	Noon.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Midnight.	Mean.
Northfield, Vt	8.4	8.7	8.5	8.4	8.2	9.2	8.6	8.6	8.6	8.5	10.0	10.6	11.9	11.5	11.4	11.2	9.5	9.2	9.6	8.4	8.9	9.6	9.9	9.5	9.5
North Platte, Nebr	7.4	7.7	7.5	7.2	7.3	7.2	7.4	7.1	6.8	7.2	8.3	9.7	11.2	12.6	13.2	13.0	12.3	10.5	8.5	8.5	7.6	7.0	6.9	7.5	8.7
Olahoma, Okla	7.1	7.1	8.1	8.0	8.0	7.7	7.3	7.7	7.9	8.5	9.8	10.9	11.3	11.9	12.1	11.5	10.9	9.0	7.6	7.4	7.7	7.6	7.7	8.1	8.8
Omaha, Nebr	7.1	7.3	7.1	7.2	7.5	7.6	7.5	7.0	6.9	6.8	7.8	8.0	7.7	7.5	7.7	8.1	7.5	7.0	6.6	7.1	7.7	7.4	7.1	7.4	7.4
Oswego, N. Y	14.1	14.3	13.8	14.5	14.5	14.4	14.4	14.4	14.6	14.9	15.5	15.5	16.1	16.5	16.4	16.0	15.6	15.7	15.5	14.9	14.5	14.9	14.2	14.5	15.0
Palestine, Tex	7.4	7.4	7.4	7.1	7.5	7.5	7.1	6.9	7.0	7.6	8.7	9.4	9.8	9.6	10.0	10.4	10.4	9.6	8.2	6.7	7.1	7.2	7.1	7.4	8.1
Parkersburg, W. Va	6.5	6.4	6.7	6.3	6.8	6.5	6.9	6.7	7.0	7.5	8.1	8.5	8.6	8.8	8.7	8.5	7.6	6.8	7.2	7.3	7.3	7.7	7.8	6.6	7.4
Pensacola, Fla	9.0	9.4	9.6	10.0	9.8	9.6	10.3	9.8	9.3	10.4	10.4	9.7	9.8	10.0	10.6	10.8	10.8	9.6	8.4	8.8	9.2	9.5	10.2	10.2	9.8
Philadelphia, Pa	9.5	9.1	9.3	9.3	9.3	9.0	9.4	9.9	10.3	11.0	11.6	12.5	13.0	12.4	12.8	12.3	11.4	10.8	10.8	10.7	10.2	9.7	9.5	9.6	10.6
Phenix, Ariz	4.1	3.7	3.4	3.7	3.5	3.5	3.7	4.0	3.7	3.4	3.7	4.3	5.0	5.3	5.4	5.5	5.7	5.0	4.5	3.4	3.8	3.7	3.4	3.5	4.1
Pierre, S. Dak	7.1	6.7	6.7	6.1	5.8	5.9	5.6	5.7	5.6	6.2	7.2	9.5	11.8	12.3	12.8	12.8	12.0	10.8	10.1	9.3	8.6	7.8	7.5	6.4	8.3
Pittsburg, Pa	7.1	6.8	6.6	6.8	7.1	6.5	6.7	7.1	7.5	8.0	8.8	9.2	9.8	8.9	9.2	8.6	7.9	7.5	7.3	7.3	7.6	7.6	7.8	7.3	7.7
Point Reyes Lt., Cal	14.7	15.1	14.3	14.6	14.8	14.2	13.4	13.1	14.4	13.9	13.5	12.4	12.6	12.2	12.4	12.2	12.6	13.2	14.6	15.1	15.7	15.3	15.3	16.0	14.0
Port Huron, Mich	13.8	13.3	13.7	13.3	13.3	12.7	12.4	12.6	12.9	12.9	13.5	13.8	14.6	14.9	14.0	14.1	14.3	14.0	13.5	13.2	14.4	14.4	14.6	14.1	13.7
Port Crescent, Wash	3.1	3.5	3.3	3.4	3.7	3.6	3.3	3.4	3.4	3.3	3.3	2.8	3.4	3.7	4.3	4.7	5.0	4.8	4.0	3.8	4.0	3.8	3.9	3.5	3.7
Portland, Me	7.7	7.8	7.2	7.4	7.8	7.6	7.9	7.2	6.9	7.5	7.9	8.0	7.9	8.1	7.4	7.0	6.9	7.4	7.5	7.6	7.1	6.7	7.5	7.8	7.5
Portland, Oreg	8.2	8.5	8.7	9.0	8.2	8.6	8.4	8.5	8.6	8.9	7.9	8.4	9.2	10.1	10.0	10.0	9.7	9.6	10.0	9.1	8.3	7.3	7.9	8.0	8.8
Pueblo, Colo	5.3	4.6	4.4	5.5	6.2	6.4	6.1	5.8	6.8	6.6	6.2	6.1	5.9	5.6	6.8	7.5	7.7	7.5	6.3	4.9	4.9	5.4	5.4	5.0	6.0
Raleigh, N. C	6.3	6.1	5.8	5.7	5.4	5.7	5.7	5.7	5.6	6.7	7.1	7.2	7.6	8.3	8.3	8.4	6.9	6.2	6.0	6.1	6.0	6.1	6.2	6.8	6.5
Rapid City, S. Dak	8.3	7.3	7.0	7.3	7.9	7.9	8.3	7.3	7.1	7.3	7.6	7.7	8.4	10.1	10.5	10.3	10.9	9.3	7.1	6.5	6.3	7.0	7.5	7.6	8.0
Red Bluff, Cal	4.5	5.4	5.4	5.1	5.0	5.4	5.3	5.3	5.1	4.7	4.7	4.5	5.7	6.1	6.8	7.1	7.0	7.5	7.1	6.3	5.6	5.5	5.3	4.7	5.6
Richmond, Va	5.3	5.2	5.0	5.1	4.6	4.7	4.8	4.7	5.1	6.2	7.1	7.1	7.0	7.7	7.9	7.2	6.3	6.2	5.9	6.1	6.5	6.5	6.5	6.0	6.0
Rochester, N. Y	9.8	9.8	9.9	10.0	9.7	9.5	9.8	10.0	10.2	10.6	10.9	10.9	11.5	12.0	11.9	11.5	10.7	9.5	10.0	10.2	10.4	10.0	9.9	10.1	10.4
Roseburg, Oreg	2.5	2.1	2.2	3.0	2.5	2.6	2.4	2.1	2.4	2.4	2.5	2.7	2.6	2.6	3.0	3.3	3.6	3.8	3.2	2.9	3.0	2.5	2.7	2.5	2.7
Sacramento, Cal	7.0	7.5	7.2	7.4	7.0	7.0	7.0	6.9	7.4	7.0	6.3	5.9	6.5	6.5	6.9	7.4	7.7	7.2	6.9	7.2	7.0	7.1	7.4	6.8	7.0
St. Louis, Mo	11.5	11.4	10.9	10.7	10.7	11.1	10.9	11.3	12.0	12.3	12.2	12.0	13.0	13.4	13.5	13.1	12.9	11.7	11.2	11.2	11.9	12.2	11.8	11.3	11.8
St. Paul, Minn	6.9	6.6	6.6	6.5	6.6	6.6	6.8	6.7	7.0	7.2	8.0	8.5	8.4	8.4	9.1	9.0	8.8	7.6	6.6	7.0	7.1	6.7	7.4	6.7	7.4
Salt Lake City, Utah	4.6	4.5	4.3	4.5	3.9	4.4	4.3	4.9	4.5	4.1	4.2	4.7	5.5	6.5	7.0	7.8	7.5	6.6	5.9	4.8	4.1	4.0	5.2	4.7	5.1
San Antonio, Tex	7.7	7.4	7.6	7.8	7.9	8.2	9.5	10.4	9.5	9.5	11.5	11.8	12.7	13.5	14.2	13.6	13.1	12.1	10.2	9.0	8.4	8.1	8.1	8.0	10.0
San Diego, Cal	3.7	3.9	3.9	4.3	4.6	5.0	4.5	4.4	5.0	4.6	4.0	3.2	4.0	5.0	6.4	6.9	8.3	8.4	7.3	5.4	4.5	3.8	3.7	4.0	5.0
Sandusky, Ohio	10.0	9.6	10.0	10.0	9.8	9.9	9.9	10.4	10.1	10.3	11.0	11.1	11.0	11.0	10.8	10.5	10.4	9.5	9.7	9.7	10.8	10.8	11.2	10.8	10.3
San Francisco, Cal	6.8	6.3	6.2	6.6	6.4	6.7	7.4	6.8	7.0	7.0	7.4	7.8	8.0	7.3	6.7	7.2	7.6	7.4	6.7	6.1	6.4	6.2	6.4	6.7	6.9
San Luis Obispo, Cal	4.5	4.3	3.8	3.8	4.3	4.6	4.5	4.3	4.2	4.4	4.5	5.1	5.6	5.7	6.0	6.4	7.4	7.2	7.3	6.8	6.1	5.0	4.4	4.0	5.2
Santa Fe, N. Mex	6.3	5.9	5.9	5.8	5.6	6.2	6.6	6.9	6.5	6.5	6.8	7.9	8.4	9.0	10.0	9.8	8.7	8.4	7.4	6.1	5.7	5.6	5.9	6.2	7.0
Sault Ste. Marie, Mich	8.5	9.2	9.8	9.7	8.7	9.1	9.2	8.9	8.6	8.3	9.3	9.4	9.6	9.9	10.4	10.3	9.5	9.1	8.8	8.5	9.2	9.0	9.1	9.1	9.2
Savannah, Ga	7.8	8.2	7.5	7.5	7.6	7.5	7.6	7.9	8.3	8.5	9.1	9.5	10.2	10.0	10.1	9.9	9.5	8.6	7.9	7.6	8.0	7.9	8.1	8.4	8.5
Seattle, Wash	6.0	6.2	5.7	5.7	5.9	6.2	5.7	5.5	5.3	5.0	4.9	4.6	4.7	4.9	5.4	5.3	6.3	5.9	5.5	4.8	5.3	5.2	4.6	5.7	5.4
Shreveport, La	7.4	7.2	7.0	6.8	6.4	7.2	7.2	6.9	7.0	7.8	8.1	8.4	8.5	9.2	9.5	9.6	9.5	8.5	7.6	7.4	7.9	8.1	7.8	7.9	7.9
Sioux City, Iowa	9.8	10.4	11.3	11.1	10.9	12.0	10.6	11.3	11.1	11.5	10.9	11.0	11.4	11.7	12.2	12.2	12.4	11.8	10.8	10.9	11.9	11.1	11.1	9.7	11.2
Spokane, Wash	4.8	4.5	3.8	4.9	4.6	4.0	4.3	4.1	4.4	4.2	4.4	4.5	5.0	5.2	5.4	5.7	5.3	5.2	5.2	5.3	5.2	5.0	4.5	4.8	4.8
Springfield, Ill	10.4	10.4	9.6	9.8	9.6	9.9	9.8	9.9	10.1	10.8	11.8	12.6	12.9	13.3	12.8	12.8	11.9	10.6	9.8	10.0	10.0	10.1	9.9	10.1	10.8
Springfield, Mo	10.5	10.1	10.8	10.5	10.2	10.6	10.9	10.4	10.4	10.8	11.3	12.1	12.6	12.6	12.7	13.3	12.7	11.5	10.6	10.5	10.1	9.5	9.6	10.2	11.0
Tacoma, Wash	5.5	5.3	4.9	5.1	5.1	4.9	4.3	4.6	4.8	4.8	4.6	4.4	4.1	4.6	5.5	5.1	6.4	6.0	6.5	5.9	5.8	5.8	5.7	5.6	5.2
Tampa, Fla	5.7	6.0	6.1	5.7	5.5	5.6	5.8	6.4	6.6	7.4	7.8	8.3	8.3	7.9	8.4	8.7	7.6	7.2	6.5	5.9	5.9	5.9	5.8	5.5	6.7
Toledo, Ohio	12.8	12.4	12.1	12.5	12.3	12.3	12.2	12.5	12.2	13.2	14.0	13.9	14.3	14.4	14.4	14.1	13.5	12.7	13.4	13.1	13.5	13.3	13.4	12.9	13.1
Vicksburg, Miss	7.6	6.7	7.2	7.3	6.9	6.6	6.7	7.3	7.2	7.6	7.9	7.8	8.4	8.5	8.7	8.4	7.8	7.9	7.6	7.7	7.5	8.3	8.0	7.8	7.6
Vineyard Haven, Mass	11.1	10.1	9.9	9.8	9.9	9.6	9.7	9.3	9.9	10.6	11.3	12.0	12.3	11.7	11.4	11.0	11.1	11.0	10.6	10.9	11.0	11.2	11.2	11.1	10.7
Walla Walla, Wash	4.6	4.7	4.8	4.8	4.6	4.3	4.5	4.4	4.4	4.8	4.5	4.5	4.6	5.2	5.4	5.9	5.9	5.2	5.0	4.5	4.7	4.5	4.1	4.5	4.8
Washington, D. C	4.5	4.8	5.0	5.1	5.3	5.2	5.3	4.6	4.5	6.1	8.0	8.8	9.4	9.5	9.5	8.4	7.3	6.0	6.1	5.8	5.7	5.4	5.2	5.2	6.3
Wichita, Kans	8.6	8.8	8.7	8.1	8.4	8.9	8.7	8.8	8.8	9.1	10.4	10.9	11.1	11.6	11.2	10.9	10.5	9.5	7.6	7.5	7.5	7.5	8.7	8.6	9.2
Williston, N. Dak	7.2	7.5	7.4	7.8	8.9	9.0	9.5	9.9	8.6	8.1	7.6	8.7	11.0	11.1	11.5	11.0	10.0	9.1	8.7	8.9	8.6	8.1	7.6	7.7	8.9
Wilmington, N. C	7.5	7.2	7.0	6.9	6.5	6.8	6.4	6.6	7.2	7.8	7.8	9.5	9.9	9.9	9.5	9.2	8.4	7.0	7.2	7.4	7.0	7.5	7.7	7.7	7.7
Winnemucca, Nev	9.0	8.8	7.9	7.8	7.8	8.3	9.2	9.1	9.2	10.1	10.2	9.3	9.6	10.9	11.5	11.6	12.0	11.5	11.5	10.5	9.5	8.7	8.6	9.2	9.6
Woods Hole, Mass	13.0	11.9	10.9	11.4	11.6	11.5	12.4	12.0	12.4	12.0	12.0	11.9	12.6	12.5	12.5	12.7	13.6	13.6	12.6	13.0	12.8	13.2	12.8	12.5	12.4
Yankton, S. Dak	8.6	8.5	8.5	8.9	8.7	8.3	8.7	8.1	7.9	7.4	7.4	8.7	9.2	9.9	9.9	10.1	9.5	8.6	7.9	7.4	7.1	7.0	7.4	7.8	8.4
West Indies.																									
Basseterre, St. Kitts	8.0	9.0	8.6	8.5	8.3	8.5	8.8	9.8	10.5	11.0	11.0	10.7	10.7	10.7	10.1	9.5	8.9	8.3	8.4	9.3	9.4	9.4	9.0	9.4	9.4
Bridgetown, Bar	4.9	5.7	5.6	5.9	6.1	6.0	6.6	10.3	12.3	12.9	13.1	12.9	12.6	12.3	11.5	10.4	7.8	6.1	5.8	6.1	6.0	5.6	5.6	5.3	8.2
Colon, U. S. C	6.4	6.5	6.5	6.5	6.5	6.2	6.1	5.9	6.3	6.3	7.2	8.2	8.6	8.7	8.5	8.5	7.9	7.5	7.1	7.0	7.0	7.2	6.9	6.9	7.1
Port of Spain, Trin'd	1.8	2.1	2.1	2.1	2.0	1.8	2.0	2.6	4.2	6.1	6.6	7.3	7.5	7.4	6.9	6.1	4.5	2.7	2.3	2.2	2.0	2.2	2.3	2.0	3.7
Santiago de Cuba.*	3.7	3.5	4.0	3.6	3.9	4.1	4.2	4.6	6.7	6.9	7.2	6.7	7.2	7.3	7.2	6.0	4.8	3.6	3.8	4.5	4.3	4.0	3.9	3.7	5.0
Santo Domingo, S. D.	8.2	3.3	3.6	3.5	3.5	3.5	3.4	4.0	4.5	4.5	4.8	4.8	5.5	5.5	5.4	5.0	4.3	3.1	2.5	2.7	3.0	3.1	3.1	3.2	3.9
Willemstad, Curaçao	7.6	7.1	7.5	7.3	7.3	7.3	7.7	10.1	11.9	12.7	13.3	13.3	13.1	12.7	12.6	12.1	11.0	9.3	8.3	8.7	8.3	7.5	7.5	7.4	9.6

* For 26 days.

TABLE VII.—*Resultant winds from observations at 8 a. m. and 8 p. m., daily, during the month of December, 1898.*

Stations.	Component direction from— N.	S.	E.	W.	Resultant. Direction from—	Duration.
	Hours.	*Hours.*	*Hours.*	*Hours.*	°	*Hours.*
New England.						
Eastport, Me	18	10	12	35	n. 71 w.	24
Portland, Me	21	19	6	35	n. 86 w.	29
Northfield, Vt	13	41	5	12	s. 14 w.	29
Boston, Mass	13	15	9	39	s. 86 w.	30
Nantucket, Mass	25	12	9	34	n. 63 w.	28
Woods Hole, Mass.*	5	12	5	15	s. 55 w.	12
Block Island, R. I	20	9	10	34	n. 65 w.	26
New Haven, Conn	21	17	7	32	n. 81 w.	25
Middle Atlantic States.						
Albany, N. Y	14	28	6	22	s. 49 w.	21
Binghamton, N. Y.†	8	7	10	14	n. 76 w.	4
New York, N. Y	22	14	10	32	n. 70 w.	23
Harrisburg, Pa.†	5	7	6	18	s. 81 w.	12
Philadelphia, Pa	20	17	8	32	n. 83 w.	24
Atlantic City, N. J	19	14	8	35	n. 80 w.	28
Cape May, N. J	15	19	8	32	s. 81 w.	24
Baltimore, Md	14	18	11	33	s. 80 w.	22
Washington, D. C	23	19	6	29	n. 80 w.	23
Lynchburg, Va	18	23	8	36	s. 80 w.	28
Norfolk, Va	18	23	10	22	s. 67 w.	13
Richmond, Va	18	26	9	20	s. 54 w.	14
South Atlantic States.						
Charlotte, N. C	15	27	16	18	s. 9 w.	12
Hatteras, N. C	24	16	3	27	n. 72 w.	25
Raleigh, N. C	17	19	9	30	s. 85 w.	21
Wilmington, N. C	22	17	7	26	n. 75 w.	20
Charleston, S. C	24	16	9	24	n. 62 w.	17
Augusta, Ga	19	17	10	31	n. 85 w.	21
Savannah, Ga	24	18	8	24	n. 69 w.	17
Jacksonville, Fla	25	20	7	21	n. 70 w.	15
Florida Peninsula.						
Jupiter, Fla	14	18	18	22	s. 45 w.	6
Key West, Fla	19	12	38	5	n. 78 e.	34
Tampa, Fla	28	13	20	13	n. 25 e.	17
Eastern Gulf States.						
Atlanta, Ga	21	16	15	30	n. 72 w.	16
Pensacola, Fla	33	12	17	16	n. 3 e.	21
Mobile, Ala	34	15	7	13	n. 18 w.	20
Montgomery, Ala	24	17	17	19	n. 16 w.	7
Vicksburg, Miss	21	17	20	14	n. 56 e.	7
New Orleans, La	30	13	14	14	n.	17
Western Gulf States.						
Shreveport, La	23	16	21	20	n. 8 e.	7
Fort Smith, Ark	17	10	23	23	n.	7
Little Rock, Ark	16	25	14	24	n. 42 w.	15
Corpus Christi, Tex	29	10	8	15	n. 20 w.	20
Fort Worth, Tex†	14	8	3	15	n. 53 w.	10
Galveston, Tex	24	15	21	15	s. 29 e.	12
Palestine, Tex	29	18	12	16	n. 20 w.	12
San Antonio, Tex	34	12	13	10	n. 8 e.	22
Ohio Valley and Tennessee.						
Chattanooga, Tenn	16	17	19	25	s. 80 w.	6
Knoxville, Tenn	22	20	12	24	n. 81 w.	12
Memphis, Tenn	20	21	18	18	s.	1
Nashville, Tenn	20	21	9	25	s. 87 w.	16
Lexington, Ky	15	25	9	24	s. 56 w.	18
Louisville, Ky	13	32	7	24	s. 42 w.	26
Evansville, Ind.†	7	14	4	14	s. 55 w.	12
Indianapolis, Ind	14	26	5	29	s. 63 w.	27
Cincinnati, Ohio	8	25	13	32	s. 48 w.	26
Columbus, Ohio	8	32	8	26	s. 37 w.	30
Pittsburg, Pa	17	21	7	36	s. 82 w.	29
Parkersburg, W. Va	12	28	7	26	s. 50 w.	25
Lower Lake Region.						
Buffalo, N. Y	10	18	7	38	s. 76 w.	32
Oswego, N. Y	11	31	10	26	s. 39 w.	26
Rochester, N. Y	10	25	5	37	s. 65 w.	35
Erie, Pa	11	29	5	34	s. 58 w.	34
Cleveland, Ohio	6	38	10	21	s. 19 w.	34
Sandusky, Ohio	6	26	6	37	s. 57 w.	37
Toledo, Ohio	8	24	5	39	s. 65 w.	38
Detroit, Mich	11	27	6	37	s. 70 w.	33
Upper Lake Region.						
Alpena, Mich	14	17	2	39	s. 85 w.	37
Escanaba, Mich	19	14	1	43	n. 83 w.	42
Grand Haven, Mich	22	14	11	32	n. 69 w.	22
Marquette, Mich	14	20	3	42	s. 81 w.	40
Port Huron, Mich	11	31	4	26	s. 51 w.	28
Sault Ste. Marie, Mich	15	19	22	20	s. 27 e.	4
Chicago, Ill	14	18	4	27	s. 80 w.	23
Milwaukee, Wis	18	11	3	46	n. 81 w.	44
Green Bay, Wis	13	27	2	36	s. 68 w.	37
Duluth, Minn	13	28	6	37	s. 64 w.	34
North Dakota.						
Moorhead, Minn	19	20	14	30	s. 87 w.	16
Bismarck, N. Dak	32	8	9	30	n. 41 w.	32
Williston, N. Dak	23	17	7	32	n. 77 w.	24

Stations.	Component direction from— N.	S.	E.	W.	Resultant. Direction from—	Duration.
	Hours.	*Hours.*	*Hours.*	*Hours.*	°	*Hours.*
Upper Mississippi Valley.						
St. Paul, Minn	19	18	8	34	n. 88 w.	26
La Crosse, Wis.†	9	14	4	12	s. 58 w.	9
Davenport, Iowa	13	17	5	42	s. 84 w.	37
Des Moines, Iowa	25	9	2	37	n. 65 w.	38
Dubuque, Iowa	18	20	6	34	s. 86 w.	28
Keokuk, Iowa	21	22	3	36	s. 88 w.	33
Cairo, Ill	22	23	8	20	s. 85 w.	12
Springfield, Ill	19	22	4	31	s. 84 w.	27
Hannibal, Mo.†	9	11	3	16	s. 81 w.	13
St. Louis, Mo	16	27	2	30	s. 68 w.	30
Missouri Valley.						
Columbia, Mo.*	11	9	3	16	n. 81 w.	13
Kansas City, Mo	22	25	7	27	s. 81 w.	20
Springfield, Mo	17	23	7	24	s. 71 w.	18
Lincoln, Nebr	25	18	3	25	n. 60 w.	26
Omaha, Nebr	27	12	2	26	n. 58 w.	28
Sioux City, Iowa†	14	8	2	14	n. 63 w.	13
Pierre, S. Dak	18	10	13	29	n. 63 w.	18
Huron, S. Dak	19	17	10	31	n. 85 w.	21
Yankton, S. Dak†	10	5	1	18	n. 74 w.	18
Northern Slope.						
Havre, Mont	9	21	10	39	s. 68 w.	31
Miles City, Mont	11	29	3	28	s. 54 w.	31
Helena, Mont	9	23	8	35	s. 63 w.	30
Rapid City, S. Dak	21	6	4	46	n. 70 w.	45
Cheyenne, Wyo	36	6	1	38	n. 51 w.	48
Lander, Wyo	12	28	22	21	s. 3 e.	16
North Platte, Nebr	30	8	4	38	n. 57 w.	40
Middle Slope.						
Denver, Colo	15	32	13	12	s. 3 e.	17
Pueblo, Colo	24	8	13	30	n. 74 w.	23
Concordia, Kans	14	23	6	23	s. 62 w.	19
Dodge, Kans	22	10	5	36	n. 69 w.	33
Wichita, Kans	27	21	6	21	n. 68 w.	16
Oklahoma, Okla	24	22	6	20	n. 82 w.	14
Southern Slope.						
Abilene, Tex	27	21	5	24	n. 72 w.	20
Amarillo, Tex	26	16	4	23	n. 62 w.	22
Southern Plateau.						
El Paso, Tex	35	2	17	30	n. 21 w.	36
Santa Fe, N. Mex	33	11	30	7	n. 45 e.	32
Flagstaff, Ariz	17	17	27	16	e.	11
Phenix, Ariz	16	13	29	18	n. 75 e.	11
Yuma, Ariz	42	4	16	12	n. 6 e.	38
Independence, Cal	33	14	5	28	n. 50 w.	30
Middle Plateau.						
Carson City, Nev	25	14	26	14	n. 47 e.	16
Winnemucca, Nev	30	17	17	7	n. 38 e.	16
Salt Lake City, Utah	14	22	21	20	s. 7 e.	8
Northern Plateau.						
Baker City, Oreg	9	38	13	14	s. 2 w.	29
Boise, Idaho	17	19	15	18	s. 56 w.	4
Idaho Falls, Idaho	35	21	4	6	n. 8 w.	14
Spokane, Wash	22	22	12	21	w.	9
Walla Walla, Wash	4	40	9	17	s. 10 w.	36
North Pacific Coast Region.						
Fort Canby, Wash	9	9	41	9	e.	32
Neah, Wash	0	11	33	21	s. 47 e.	16
Port Crescent, Wash.*	0	9	15	11	s. 24 e.	10
Seattle, Wash	12	32	27	7	s. 45 e.	28
Tacoma, Wash	12	33	10	23	s. 31 w.	25
Portland, Oreg	15	19	28	14	s. 74 e.	15
Roseburg, Oreg	17	16	26	18	n. 83 e.	8
Middle Pacific Coast Region.						
Eureka, Cal	17	24	17	23	s. 41 w.	9
Mount Tamalpais, Cal	29	10	23	19	n. 12 e.	19
Red Bluff, Cal	39	9	10	15	n. 9 w.	30
Sacramento, Cal	36	16	21	8	n. 33 e.	24
San Francisco, Cal	37	7	13	20	n. 13 w.	31
South Pacific Coast Region.						
Fresno, Cal	16	13	16	30	n. 78 w.	14
Los Angeles, Cal	24	8	16	25	n. 34 e.	19
San Diego, Cal	26	8	27	14	n. 36 e.	22
San Luis Obispo, Cal	45	7	8	12	n. 6 w.	38
West Indies.						
Basseterre, St. Kitts Island	24	0	48	1	n. 63 e.	53
Bridgetown, Barbados	8	1	59	0	n. 81 e.	59
Colon, U. S. C	41	3	34	3	n. 39 e.	49
Kingston, Jamaica	42	3	23	10	n. 19 e.	41
Port of Spain, Trinidad	33	5	33	3	n. 47 e.	41
Roseau, Dominica	26	3	44	1	n. 62 e.	49
San Juan, Porto Rico	4	29	39	6	s. 52 e.	41
Santiago de Cuba, Cuba	27	8	29	11	n. 43 e.	26
Santo Domingo, Santo Domingo	48	5	6	10	n. 5 e.	43
Willemstad, Curaçao	4	2	59	0	n. 88 w.	50
Alaska.						
Sitka	9	12	46	3	s. 86 e.	43

*From observations at 8 p. m. only. †From observations at 8 a. m. only.

TABLE VIII.—*Thunderstorms and auroras, December, 1898.*

States.	No. of stations.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total. No.	Total. Days.	
Alabama	53	T.		1	1																1													3	3	T.
		A.																																0	0	A.
Arizona	53	T.								1																								1	1	T.
		A.																																0	0	A.
Arkansas	57	T.			1																													1	1	T.
		A.																																0	0	A.
California	189	T.								1	3					1																		5	3	T.
		A.																																0	0	A.
Colorado	73	T.																		1														1	1	T.
		A.																																0	0	A.
Connecticut	22	T.																																0	0	T.
		A.																																0	0	A.
Delaware	5	T.																						1										1	1	T.
		A.																																0	0	A.
Dist. of Columbia	4	T.																						1										1	1	T.
		A.																																0	0	A.
Florida	45	T.																																0	0	T.
		A.																																0	0	A.
Georgia	54	T.		2	1																	11		2									2	18	5	T.
		A.																																0	0	A.
Idaho	27	T.																																0	0	T.
		A.																																0	0	A.
Illinois	92	T.																																0	0	T.
		A.		1																														1	1	A.
Indiana	55	T.																																0	0	T.
		A.																																0	0	A.
Indian Territory	8	T.																																0	0	T.
		A.																																0	0	A.
Iowa	126	T.																																0	0	T.
		A.		1																														1	1	A.
Kansas	74	T.																																0	0	T.
		A.																																0	0	A.
Kentucky	45	T.																																0	0	T.
		A.																																0	0	A.
Louisiana	45	T.		1	6													1		4												2	3	17	6	T.
		A.																																0	0	A.
Maine	17	T.																																0	0	T.
		A.													1			1																2	2	A.
Maryland	39	T.				2																	1	8										11	3	T.
		A.																																0	0	A.
Massachusetts	54	T.																						1										1	1	T.
		A.																																0	0	A.
Michigan	107	T.																																0	0	T.
		A.														1				1														2	2	A.
Minnesota	64	T.																																0	0	T.
		A.	1				1		1							1				1	1					1		1		1				9	9	A.
Mississippi	42	T.		1	2															2	1											2		8	4	T.
		A.																																0	0	A.
Missouri	89	T.																																0	0	T.
		A.																																0	0	A.
Montana	37	T.																																0	0	T.
		A.			1		1								2	2			1	1														8	6	A.
Nebraska	145	T.																																0	0	T.
		A.																																0	0	A.
Nevada	45	T.																																0	0	T.
		A.																																0	0	A.
New Hampshire	20	T.																																0	0	T.
		A.			1										2	1																		4	3	A.
New Jersey	50	T.				2	1														1			13								1		18	5	T.
		A.																																0	0	A.
New Mexico	38	T.																																0	0	T.
		A.																																0	0	A.
New York	103	T.											1																					1	1	T.
		A.												1	1												1							3	3	A.
North Carolina	56	T.		2		2																7		7										18	4	T.
		A.																																0	0	A.
North Dakota	40	T.																																0	0	T.
		A.						1							2					1														4	3	A.
Ohio	124	T.				1															1	2												4	3	T.
		A.		1				1	1		1	1					1														1			7	7	A.
Oklahoma	22	T.																																0	0	T.
		A.																																0	0	A.
Oregon	71	T.																			3	1								2	1			7	4	T.
		A.																																0	0	A.
Pennsylvania	100	T.														1								1										2	2	T.
		A.																1																1	1	A.
Rhode Island	8	T.																																0	0	T.
		A.																																0	0	A.
South Carolina	44	T.		2																		10	1	6									2	21	5	T.
		A.									1																							1	1	A.
South Dakota	52	T.																																0	0	T.
		A.														1																		1	1	A.
Tennessee	61	T.				1																												1	1	T.
		A.																																0	0	A.
Texas	83	T.																		3														3	1	T.
		A.																								1						1		2	2	A.
Utah	34	T.																																0	0	T.
		A.																																0	0	A.
Vermont	14	T.																																0	0	T.
		A.																																0	0	A.
Virginia	47	T.				2																1												3	2	T.
		A.																																0	0	A.
Washington	55	T.																			1													1	1	T.
		A.																																0	0	A.
West Virginia	38	T.				1																												1	1	T.
		A.																																0	0	A.
Wisconsin	60	T.																																0	0	T.
		A.													2																			2	1	A.
Wyoming	18	T.																																0	0	T.
		A.																																0	0	A.
Sums	2,804	T.	0	9	11	11	1	0	0	2	3	0	1	0	0	2	0	1	0	10	8	32	2	40	0	0	0	0	0	2	1	5	7	148	....	T.
		A.	1	3	2	0	2	2	2	0	2	1	0	1	10	6	1	2	1	4	1	0	0	0	0	2	1	1	0	1	1	1	0	48	....	A.

TABLE IX.—*Average hourly sunshine (in percentages), December, 1898.*

Stations.	Instrument.	A. M. 5	6	7	8	9	10	11	Noon	P. M. 1	2	3	4	5	6	7	8	Hours of sunshine. Total. Actual.	Possible.	Percent of possible.	Personal estimate.
																		Hours.	Hours.		
Albany, N. Y	T.				16	22	35	42	49	48	43	36	27	16				98.6	281.0	35	31
Atlanta, Ga	T.			44	32	34	42	50	50	52	51	52	45	46	0			139.7	307.7	45	43
Atlantic City, N. J	P.				50	52	57	62	65	56	54	52	52	39				159.5	293.7	54	44
Baltimore, Md	T.				43	51	71	71	71	67	73	70	48	23				176.9	293.7	60	54
Binghamton, N. Y	T.				8	21	33	43	37	42	28	21	18	13				79.4	284.7	28	25
Bismarck, N. Dak	P.				38	49	56	64	63	57	64	61	42	33				148.0	265.6	56	55
Boise	P.				41	39	44	41	41	34	38	49	41	33				112.3	277.7	40	42
Boston, Mass	T.				42	48	55	62	64	63	58	52	46	33				153.1	284.7	54	47
Buffalo, N. Y.	T.				0	6	16	21	25	31	26	15	7	7				47.2	281.0	17	11
Charleston, S. C.	T.			32	29	28	36	42	60	57	58	48	37	36	67			134.1	310.7	43	42
Chattanooga, Tenn	T.			18	20	25	39	46	51	45	41	48	47	39				122.4	305.2	40	43
Cheyenne, Wyo	P.				65	77	79	80	80	80	80	75	68	61				217.9	287.8	76	59
Chicago, Ill	T.				32	39	53	58	61	63	56	49	46	43				145.7	284.7	51	47
Cincinnati, Ohio	T.				52	52	51	56	63	67	66	57	58	51				169.5	293.7	58	51
Cleveland, Ohio	T.				13	13	14	18	23	30	31	34	27	26				66.0	284.7	23	23
Columbia, Mo	T.				56	60	64	67	70	68	72	65	65	63				191.2	293.7	65	51
Columbus, Ohio	T.				48	45	40	43	49	51	49	44	42	41				132.1	291.7	45	41
Denver, Colo	P.				75	82	88	92	90	85	89	87	85	71				248.2	291.7	85	68
Des Moines, Iowa	T.				57	55	63	61	61	61	64	52	46	47				162.8	284.7	57	53
Detroit, Mich	T.				0	5	20	32	36	38	29	22	9	4				59.6	284.7	21	22
Dodge, Kans	P.			36	54	71	76	79	76	78	81	71	74	69				217.3	296.7	73	64
Dubuque, Iowa	T.				37	43	61	63	64	72	73	63	55	53				169.3	284.7	59	54
Eastport, Me.	P.				27	35	50	45	39	40	45	39	31	21				107.2	274.3	39	32
Erie, Pa	T.				7	8	18	19	25	21	15	15	10	10				43.4	284.7	15	18
Eureka, Cal	P				37	38	46	44	58	61	58	58	52	44				144.7	287.8	50	49
Fresno, Cal.*	T.																				44
Galveston, Tex	P.			20	27	51	52	54	55	52	51	61	54	43	25			156.9	320.2	49	43
Harrisburg, Pa	T.				33	39	45	51	58	55	51	38	42	45				134.3	291.7	46	45
Helena, Mont	P.				27	33	48	55	46	54	52	51	46	39				124.9	265.6	47	44
Huron, S. Dak	T.				47	45	58	71	74	77	73	67	54	50				174.8	277.7	63	55
Idaho Falls, Idaho	T.				20	19	22	36	44	44	33	30	23	25				85.4	281.0	30	33
Indianapolis, Ind	T.				39	44	46	47	49	50	53	49	50	47				139.0	291.7	48	39
Jacksonville, Fla	T.			37	36	43	53	58	59	66	62	60	50	37	48			166.0	317.8	52	49
Kansas City, Mo.	P.				62	69	67	68	60	58	66	58	59	65				185.9	293.7	63	63
Key West, Fla	T.			31	36	56	75	82	81	86	88	77	64	44	45			220.7	329.1	67	51
Knoxville, Tenn	T.			17	32	37	55	59	61	57	66	64	58	51				163.9	302.5	54	49
Little Rock, Ark	T.			36	48	51	62	69	70	75	78	69	64	63				198.0	305.2	65	57
Los Angeles, Cal	P.			67	74	74	75	74	74	79	78	77	68	62	100			226.0	307.7	73	64
Louisville, Ky.	T.			100	50	47	48	55	52	51	46	35	47	44				141.7	296.7	48	42
Minneapolis, Minn	T.				44	45	59	71	74	72	73	70	58	53				174.2	274.3	64	
Nashville, Tenn	T.			17	35	39	59	61	68	67	62	56	48	44				164.1	302.5	54	54
New Orleans, La	T.			19	13	7	16	26	25	34	32	32	18	29	48			74.1	317.8	23	33
New York, N. Y	T.				28	44	55	62	58	60	56	54	43	35				146.3	28[illegible].8	51	42
Northfield, Vt	P.				14	16	38	41	39	33	37	28	14	9				80.0	277.7	29	22
Oklahoma, Okla	T.			45	60	64	65	71	75	71	67	68	69	66				206.1	305.2	68	63
Omaha, Nebr	P.				58	60	66	67	58	73	76	70	60	50				186.2	287.8	65	60
Parkersburg, W. Va	T.				25	29	88	59	63	60	58	[illegible]	41	39				137.8	293.7	47	48
Phenix, Ariz	P.			56	67	72	75	79	78	77	79	74	68	65	100			227.7	310.7	73	65
Philadelphia, Pa	T.				44	48	58	58	65	63	56	55	46	41				158.0	291.7	54	40
Pittsburg, Pa	T.				12	17	30	35	37	37	35	21	19	20				78.1	287.8	27	29
Portland, Me	T.				25	38	56	60	73	70	65	58	42	28				151.1	277.7	54	45
Portland, Oreg	T.				30	26	30	35	36	39	31	31	30	25				85.8	269.6	32	35
Raleigh, N. C	T.			0	20	30	45	49	52	53	53	53	44	31				131.0	302.5	43	45
Rochester, N. Y	T.				8	4	8	15	17	11	15	15	9	3				31.2	281.0	11	12
St. Louis, Mo	T.				43	51	58	63	72	75	71	65	59	50				180.8	293.7	62	55
St. Paul, Minn	P.				49	52	56	71	69	65	70	64	64	58				172.0	274.3	63	60
Salt Lake City, Utah	P.				45	45	49	52	56	60	65	57	55	44				153.6	287.8	53	46
San Diego, Cal	P.			76	73	74	76	79	82	80	84	80	76	73	100			241.7	310.7	78	74
San Francisco, Cal	T.				31	58	74	76	86	87	85	83	75	39				210.3	296.7	71	53
Santa Fe, N. Mex.	P.			83	67	67	70	73	73	75	75	82	82	80				225.2	302.5	74	70
Savannah, Ga.	T.			30	32	38	50	53	53	60	55	50	46	42	67			149.9	313.0	48	43
Seattle, Wash	T.				13	18	30	35	48	54	51	44	31	18				98.1	262.1	37	33
Spokane, Wash	T.				10	12	29	45	50	62	49	31	33	31				98.6	262.1	38	40
Tacoma, Wash	T.				12	12	22	30	36	37	35	31	26	23				74.1	265.6	28	26
Tampa, Fla	T.			42	38	46	63	59	65	64	60	50	36	27	32			162.6	322.9	50	42
Topeka, Kans	T.				59	57	64	69	70	65	63	65	57	53				184.1	293.7	63	
Vicksburg, Miss	T.			21	19	22	38	47	49	54	53	51	38	26	33			123.5	313.0	39	40
Washington, D. C.	P.				43	43	52	55	57	60	61	62	60	54				161.0	293.7	55	51
Wilmington, N. C.	T.			22	14	27	35	49	50	53	51	53	40	27	0			123.3	307.7	40	37
Yankton, S. Dak	T.				54	62	77	84	90	94	87	80	70	47				216.4	281.0	77	49
Bridgetown, Barbados	T.			30	53	56	63	60	50	45	37	29	19	22	18			144.7	353.4	41	37
Colon, United States of Columbia	T.			20	33	33	48	61	66	69	76	66	52	36	16			176.9	359.6	49	47
Kingston, Jamaica, W. I	T.			0	2	42	85	88	77	73	64	47	12	0	0			152.1	344.1	44	47
Port of Spain, Trinidad, W. I.	T.			43	65	83	90	89	86	89	85	72	67	49	45			260.7	356.5	73	34
San Juan, Porto Rico†	T.			0	43	75	85	83	82	78	76	77	61	34	3			208.5	333.0	63	71
Santo Domingo, Santo Domingo, W. I.	T.			80	85	86	92	85	71	70	60	68	56	48	57			247.8	344.1	72	64
Willemstad, Curaçao	T.			22	64	83	89	93	96	95	97	96	94	85	63			294.7	355.3	83	58

*Instrument out of order. †All values for 30 days.

TABLE X.—*Accumulated amounts of precipitation for each 5 minutes, for storms in which the rate of fall equaled or exceeded* 0.25 *in any* 5 *minutes, or* 0.75 *in* 1 *hour during December,* 1898, *at all stations furnished with self-registering gauges.*

Stations.	Date.	Total duration.		Total am't of precipitation.	Excessive rate.		Amount before excessive began.	Depths of precipitation (in inches) during periods of time as indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
	1	2	3	4	5	6	7														
Albany, N. Y.	31			0.52														*			
Atlanta, Ga.	22	6.15 a.m.	1.25 p.m.	1.31	8.53 a.m.	9.08 a.m.	0.45	0.25	0.40	0.45	0.48	0.51	0.54	0.57	0.62	0.70	0.76	0.80			
Atlantic City, N. J.	22			0.66														0.35			
Baltimore, Md.	3-4			0.97														*			
Binghamton, N. Y.	19-20			0.37														*			
Bismarck, N. Dak.	27			0.20														*			
Boise, Idaho	18-19			0.24														*			
Boston, Mass.	22-23			0.48														0.22			
Buffalo, N. Y.	4-5			0.86														*			
Cairo, Ill.	18-19			0.81														0.27			
Charleston, S. C.	22			0.35														0.29			
Chicago, Ill.*																					
Cincinnati, Ohio	4-5			0.87														0.18			
Cleveland, Ohio	4-5			0.82														*			
Columbia, Mo.	18-19			0.61														0.19			
Columbus, Ohio	4-5			0.38														*			
Denver, Colo.	29-30			0.40														0.07			
Des Moines, Iowa	18-19			0.35														*			
Detroit, Mich.	4-5			1.07														*			
Dodge, Kans.	18-19			1.22														*			
Duluth, Minn.	26			0.09														*			
Eastport, Me.	12-13			0.66														*			
Erie, Pa.	7-8			1.08														*			
Fort Worth, Tex.	17-18			1.64														0.56			
Fresno, Cal.	14-15			0.32														*			
Galveston, Tex.	18			0.77														0.52			
Hannibal, Mo.	18-19			0.60														0.16			
Harrisburg, Pa.	3-4			0.92														0.20			
Hatteras, N. C.	4	7.40 a.m.	11.00 a.m.	1.54	9.20 a.m.	10.20 a.m.	0.39	0.05	0.13	0.17	0.21	0.23	0.26	0.33	0.43	0.53	0.66	1.00	1.06	1.15	
Huron, S. Dak.	2-3			0.04														*			
Idaho Falls, Idaho	28-29			0.52														*			
Indianapolis, Ind.	19			1.08														0.19			
Jacksonville, Fla.	3-4	10.25 p.m.	D. N.	0.70	11.57 p.m.	12.05 a.m.	0.03	0.55	0.67												
Jupiter, Fla.	4			0.65														0.42			
Kansas City, Mo.	3-4			0.80														*			
Key West, Fla.	2	10.50 a.m.	11.40 a.m.	1.08	11.12 a.m.	11.32 a.m.	0.05	0.15	0.45	0.55	0.75	1.00	1.03								
Knoxville, Tenn.	4			0.49														0.20			
Lincoln, Nebr.	18-19			0.26														*			
Little Rock, Ark.	17-18			0.53														0.21			
Los Angeles, Cal.	14			0.10														0.08			
Louisville, Ky.	18-19			0.78														0.31			
Memphis, Tenn.	3-4			1.76														0.37			
Milwaukee, Wis.	19-20			0.44														0.08			
Montgomery, Ala.	19			1.14														0.38			
Nantucket, Mass.	22-23			0.95														0.13			
Nashville, Tenn.	3-4			1.16														0.18			
New Orleans, La.	18			0.45														0.29			
New York, N. Y.	4			0.78														0.24			
Norfolk, Va.	20	7.10 a.m.	9.35 a.m.	0.54	7.40 a.m.	8.00 a.m.	T.	0.07	0.16	0.30	0.52										
Northfield, Vt.	4-5			0.44														*			
Oklahoma, Okla.	17-18			2.45														*			
Omaha, Nebr.	3			0.14														0.04			
Parkersburg, W. Va.	4-5			0.72														0.18			
Philadelphia, Pa.	22-23			0.98														0.24			
Pittsburg, Pa.	4-5			0.65														*			
Portland, Me.	4-5			0.97														0.17			
Portland, Oreg.	18-19			0.87														0.27			
Raleigh, N. C.	3-4			0.65														0.30			
Richmond, Va.	19-20			0.85														0.34			
Rochester, N. Y.	4-5			0.99														*			
St. Louis, Mo.	18-19			0.53														0.16			
St. Paul, Minn.	23			0.06														0.03			
Salt Lake City, Utah	29			0.60														*			
San Diego, Cal.	9			0.26														0.15			
San Francisco, Cal.	19			0.70														0.19			
Savannah, Ga.	20-21			1.07														0.30			
Seattle, Wash.	18-19			0.86														0.20			
Spokane, Wash.	4			0.50														*			
Tampa, Fla.	2-3			1.76														*			
Vicksburg, Miss.	18	12.05 p.m.	8.10 p.m.	1.47	4.30 p.m.	5.10 p.m.	0.33	0.16	0.29	0.32	0.38	0.42	0.45	0.50	0.57						
Washington, D. C.	22-23			0.84														0.28			
Wilmington, N. C.	2			0.90														0.30			
Yankton, S. Dak.	2-3			0.08														*			
Basseterre, St. Kitts	18			0.52														0.45			
Bridgetown, Barbados	25-26			0.75														0.31			
Colon, U. S. C.	11-12	7.10 p.m.	3.00 a.m.	3.84	8.38 p.m.	9.43 p.m.	0.45	0.28	0.57	0.78	1.06	1.26	1.36	1.69	2.06	2.35	2.59	2.88	3.03	3.07	
Kingston, Jamaica	18			0.05														0.05			
Port of Spain, Trin.	27	5.55 a.m.	7.00 a.m.	0.55	6.10 a.m.	6.30 a.m.	0.05	0.10	0.33	0.44	0.49										
Roseau, Dominica	23	6.50 p.m.	8.45 p.m.	1.08	7.45 p.m.	8.00 p.m.	0.32	0.17	0.43	0.57	0.61										
San Juan, Porto Rico	25	2.20 p.m.	3.47 p.m.	0.65	2.23 p.m.	2.36 p.m.	0.02	0.27	0.52	0.61											
Santiago de Cuba	6			0.04											0.04						
Santo Domingo, S. D.	23	2.25 p.m.	4.45 p.m.	0.53	2.27 p.m.	2.40 p.m.	0.01	0.16	0.34	0.39											
Willemstad, Curaçao	27			0.34							0.20										

*Record incomplete on account of snow or other causes.

TABLE XI.—*Excessive precipitation, by stations, for December*, 1898.

Stations.	Monthly rainfall 10 inches, or more	Rainfall 2.50 inches, or more, in 24 hours.		Rainfall of 1 inch, or more, in one hour.		
		Amt.	Day.	Amt.	Time.	Day.
Alabama.	*Inches.*	*Inches.*		*Ins.*	*h.m.*	
Healing Springs		2.58	18			
Pushmataha		3.75	17			
Scottsboro		3.30	18-19			
Thomasville		3.00	19			
Tuscaloosa		3.00	19			
Union		4.20	18			
Alaska.						
Sitka	10.99					
Arkansas.						
Mossville		3.43	18-19			
California.						
Bowmans Dam		2.60	19-20			
Kennedy Gold Mine		2.78	19-20			
Florida.						
Key West				1.00	0 25	2
Lake Butler		3.00	20-21			
Lake City		3.40	20-21			
Macclenny		3.36	20-21			
St. Andrews	11.80	6.10	30-31			
Sebastian		3.20	15			
Tarpon Springs		2.53	10			
Indian Territory.						
Lehigh		2.95	17-18			
Tulsa		2.66	18-19			
Louisiana.						
Mansfield		2.50	18			
Oakridge		2.82	18-19			
Mississippi.						
Biloxi		2.70	18-19			
Magnolia		2.72	18			
Missouri.						
Lebanon		2.50	12			
North Carolina.						
Beaufort		2.80	4			
Hatteras				1.00	1 00	4

TABLE XI.—*Excessive precipitation*—Continued.

Stations.	Monthly rainfall 10 inches, or more.	Rainfall 2.50 inches, or more, in 24 hours.		Rainfall of 1 inch, or more, in one hour.		
		Amt.	Day.	Amt.	Time.	Day.
Oklahoma.	*Inches.*	*Inches.*		*Ins.*	*h.m.*	
Clifton		2.54	17-18			
Edmond		2.50	18			
Guthrie		2.90	17-18			
Hennessey		3.00	17-18			
Pawhuska		4.11	18-19			
Sac and Fox Agency		4.00	17-18			
Stillwater		2.63	17-18			
Winnview		2.50	18			
Oregon.						
Astoria	11.19	2.30	24-25			
Bay City	12.00					
Glenora	14.23	3.20	19			
Government Camp	12.10					
Nehalem	16.51	4.43	25			
South Carolina.						
Gillisonville		2.76	3			
Texas.						
Alvin				1.35	1 00	18
Corsicana		2.80	17-18			
Estelle		2.52	17-18			
Gainesville		2.95	17-18			
Mann		2.60	17			
Palestine		2.50	16-17			
Waxahachie		3.20	16			
Virginia.						
Leesburg		2.83	4			
Washington.						
Aberdeen	10.92					
Cedar Lake	12.48					
Clearwater	18.05	7.57	25-26			
Fort Canby		2.99	24-25			
Neah	12.66	2.74	25-26			
West Indies.						
Colon		4.02	11-12	3.08	1 05	11

TABLE III.—*Data furnished by the Canadian Meteorological Service, December*, 1898.

Stations	Pressure.			Temperature.				Precipitation.		
	Mean not reduced.	Mean reduced.	Departure from normal.	Mean.	Departure from normal.	Mean maximum.	Mean minimum.	Total.	Departure from normal.	Depth of snow.
	Ins.	*Ins.*	*Ins.*	°	°	°	°	*Ins.*	*Ins.*	*Ins.*
St. Johns, N. F.	29.63	29.78	—.06	30.4	+ 1.7	36.6	24.2	6.03		3.5
Sydney, C. B. I.	29.83	29.87	—.01	29.3	+ 1.1	36.1	22.5	5.70	+0.98	25.0
Halifax, N. S.	29.83	29.97	+.02	30.0	+ 2.4	37.2	22.8	4.07	—1.22	17.4
Grand Manan, N. B.	29.87	29.92	—.07	28.5	+ 0.2	36.1	21.0	3.93	—0.74	19.7
Yarmouth, N. S.	29.88	29.98	.00	31.7	+ 1.0	38.7	24.7	4.31	—0.96	24.1
Charlottet'n, P. E. I.	29.85	29.89	—.03	26.6	+ 2.3	33.3	19.8	2.77	—1.23	13.7
Chatham, N. B.	29.87	29.89	—.05	18.8	+ 1.8	26.9	10.7	1.82	—1.15	11.8
Father Point, Que.	29.84	29.87	—.08	15.9	+ 0.5	24.3	7.6	1.70	—0.52	13.4
Quebec, Que.	29.57	29.92	—.09	16.5	+ 1.3	24.4	8.7	2.48	—1.83	17.1
Montreal, Que.	29.72	29.94	—.09	19.2	+ 0.9	26.6	11.8	3.20	—0.36	20.9
Rockliffe, Ont	29.38	29.93	—.10	14.7	— 0.5	23.4	6.1	2.50	—0.24	22.4
Ottawa, Ont	29.61	29.95		17.8	+ 0.8	26.4	9.2	3.13		27.2
Kingston, Ont	29.63	29.97	—.08	24.8	+ 1.1	32.7	17.0	1.68	—1.96	9.5
Toronto, Ont	29.58	29.98	—.08	26.3	— 0.7	32.9	19.8	2.55	+0.01	18.4
White River, Ont.	28.51	29.96	—.09	7.5	— 2.2	20.6	—5.6	2.09	+0.65	20.9
Port Stanley, Ont	29.34	30.01	—.06	26.9	— 1.5	32.4	21.4	3.47	+0.86	22.8
Saugeen, Ont	29.19	29.94	—.08	25.7	— 1.0	31.7	19.7	4.82	+0.69	44.0
Parry Sound, Ont	29.19	29.93	—.10	20.6	— 0.6	29.6	11.7	6.09	+2.16	52.9
Port Arthur, Ont.	29.18	29.93	—.09	12.2	— 1.0	22.3	2.1	0.28	—0.57	2.8
Winnipeg, Man.	29.13	30.03	—.07	4.3	+ 0.2	15.1	—6.5	0.61	—0.58	6.1
Minnedosa, Man.	28.11	30.05	—.05	10.2	+ 4.5	20.7	—0.4	0.14	—0.59	1.4
Qu'Appelle, Assin.	27.66	30.06	—.06	11.4	+ 4.0	19.6	3.2	0.23	—0.41	2.3
Medicine Hat, Assin.	27.70	30.10	.00	20.5	+ 2.3	31.5	9.6	0.67	+0.31	6.7
Swift Current, Assin.	27.42	30.14	+.02	17.8	+ 1.8	25.1	10.4	0.13	—0.58	1.3
Calgary, Alberta	26.38	30.06	—.06	21.4	+ 3.2	31.0	11.8	0.40	—0.38	4.0
Banff, Alberta	25.36	30.19		19.2		26.3	12.1	0.20		1.1
Edmonton, Alberta	27.61	30.00	+.01	23.0	+ 9.9	31.4	14.6	0.28	—0.12	1.0
Prince Albert, Sask.	28.35	29.98		8.9	+ 6.1	19.0	—1.2	0.29		2.9
Battleford, Sask.	28.23	30.10		10.8	+ 5.4	20.3	1.3	0.20		2.0
Kamloops, B. C.										
Esquimalt, B. C.	30.14	30.17		39.6	— 1.7	43.9	35.3	4.11		5.0
Hamilton, Bermuda	30.02	30.18	+.06	65.2	+ 0.5	69.8	60.6	1.48		

Chart I. Tracks of Centers of High Areas. December, 1898.

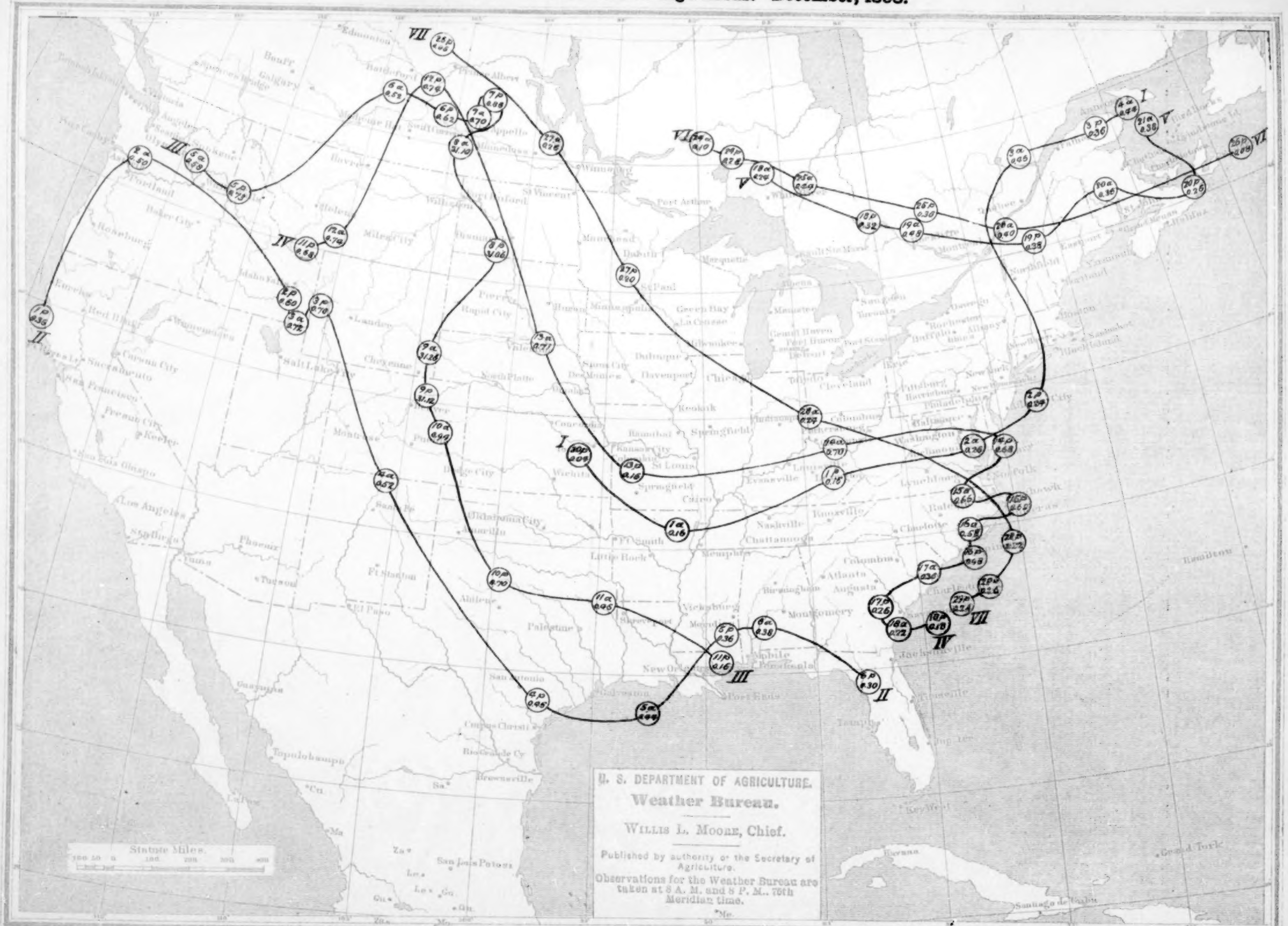


Chart II. Tracks of Centers of Low Areas. December, 1898.

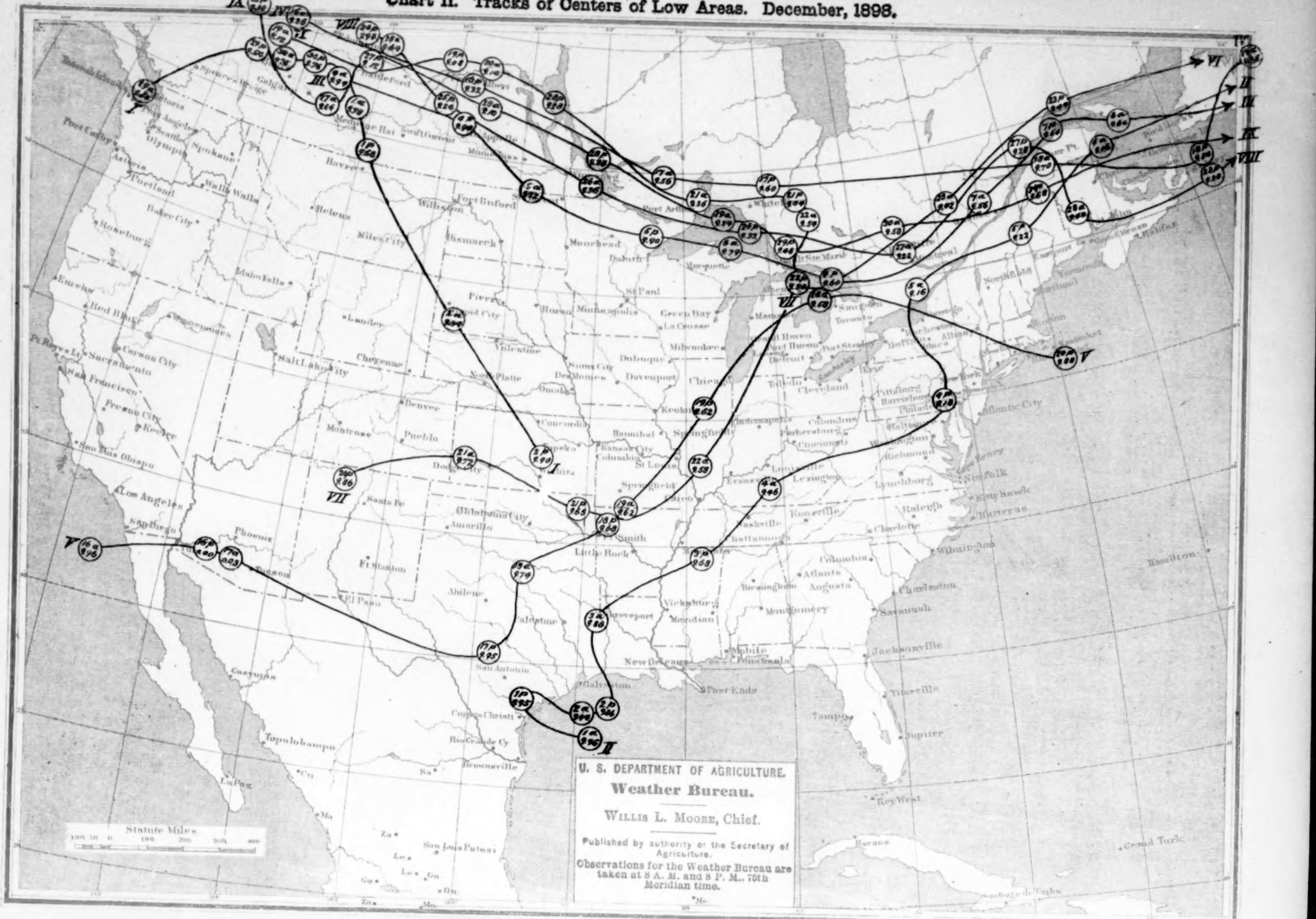


Chart III. Total Precipitation. December, 1898.

Chart III. Total Precipitation. December, 1898.

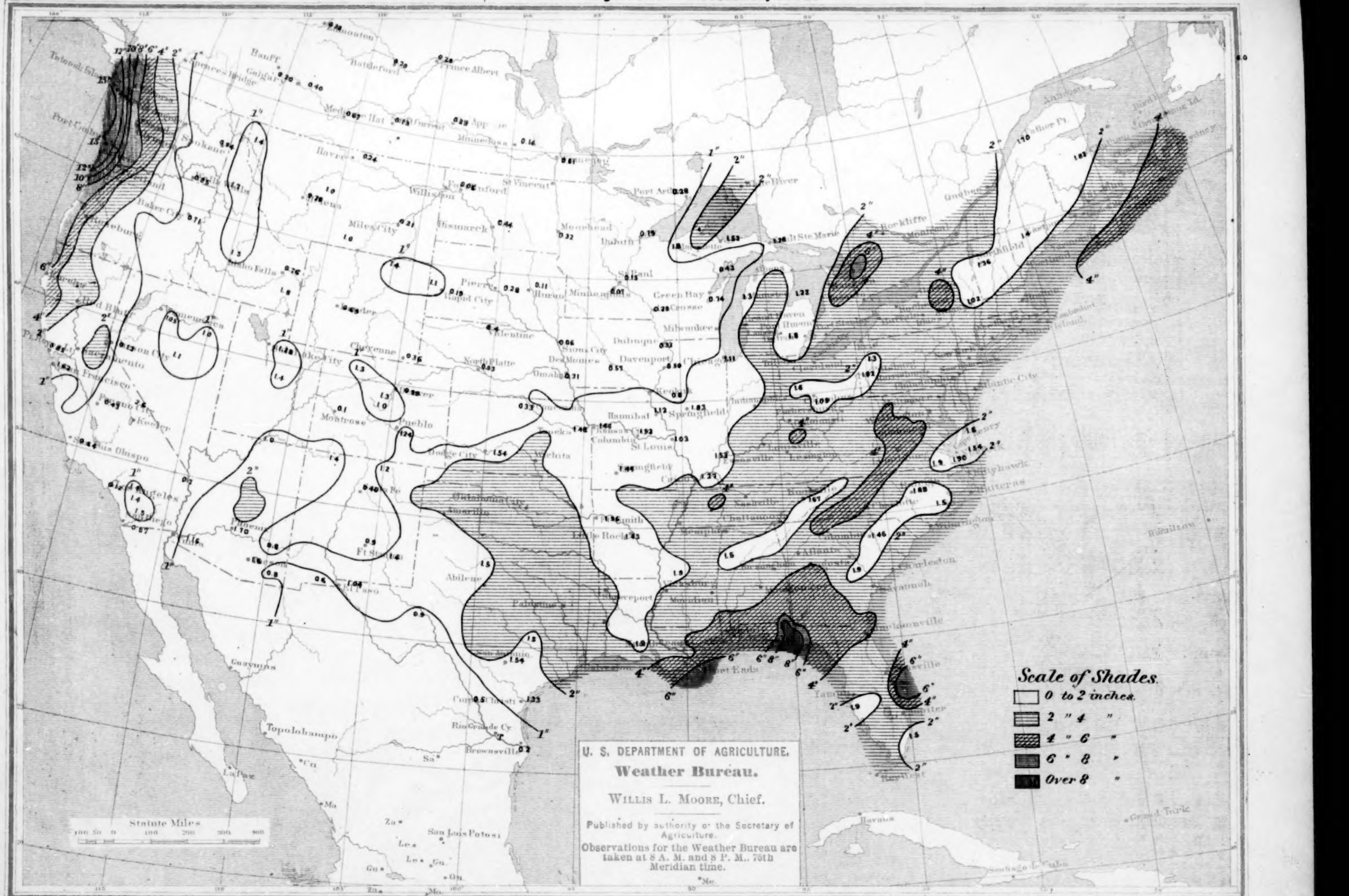
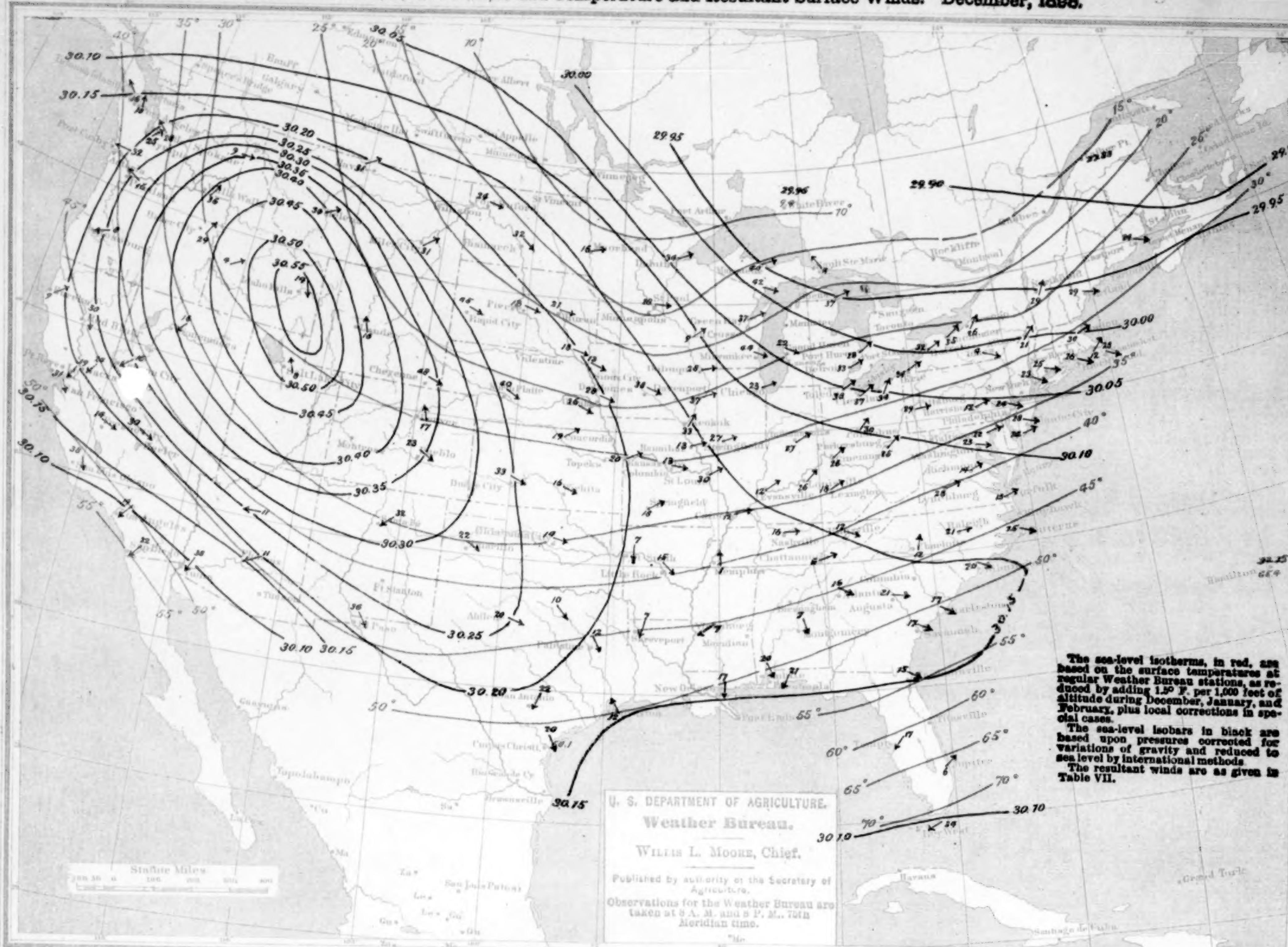


Chart IV. Sea-Level Pressure and Temperature and Resultant Surface Winds. December, 1898.



The sea-level isotherms, in red, are based on the surface temperatures at regular Weather Bureau stations, as reduced by adding 1.5° F. per 1,000 feet of altitude during December, January, and February, plus local corrections in special cases.

The sea-level isobars in black are based upon pressures corrected for variations of gravity and reduced to sea level by international methods.

The resultant winds are as given in Table VII.

Chart V. Hydrographs for Seven Principal Rivers of the United States. December, 1898.

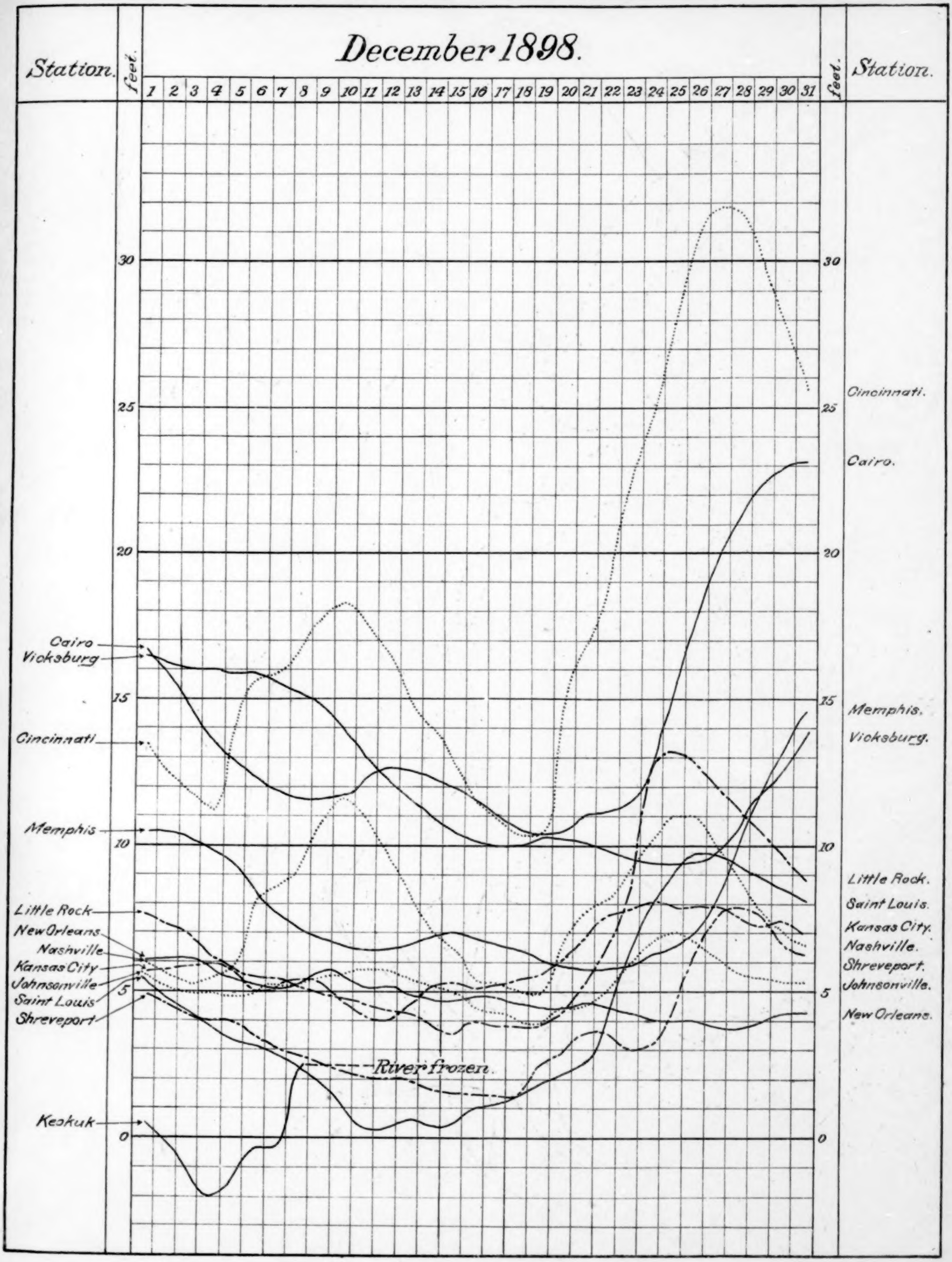


Chart VI. Surface Temperatures; Maximum, Minimum, and Mean. December, 1898.

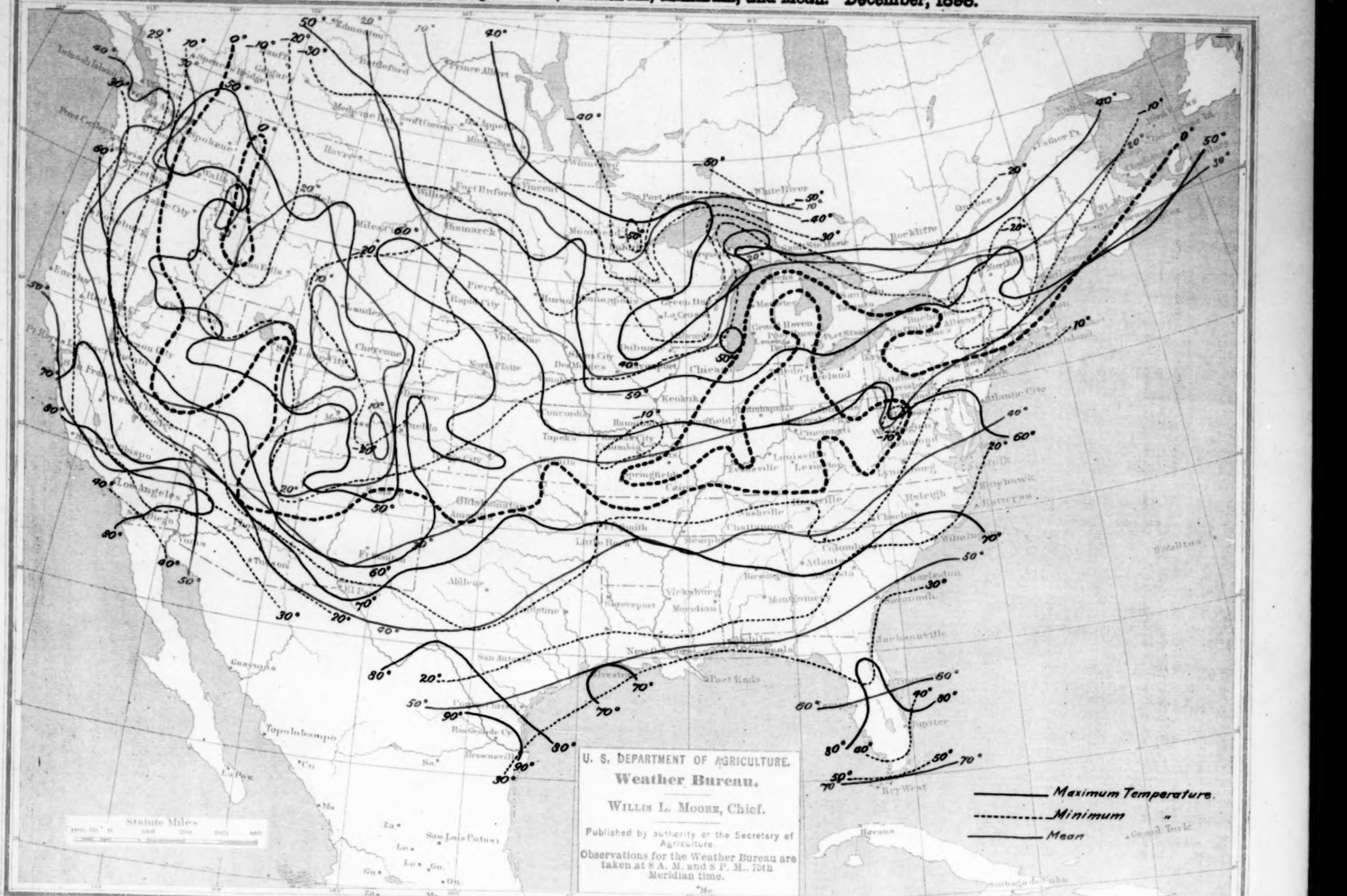


Chart VII. Percentage of Sunshine. December, 1898.

Chart VIII. Total Snowfall. December, 1898.

Chart IX. Snow on ground at the end of the month. December, 1899.

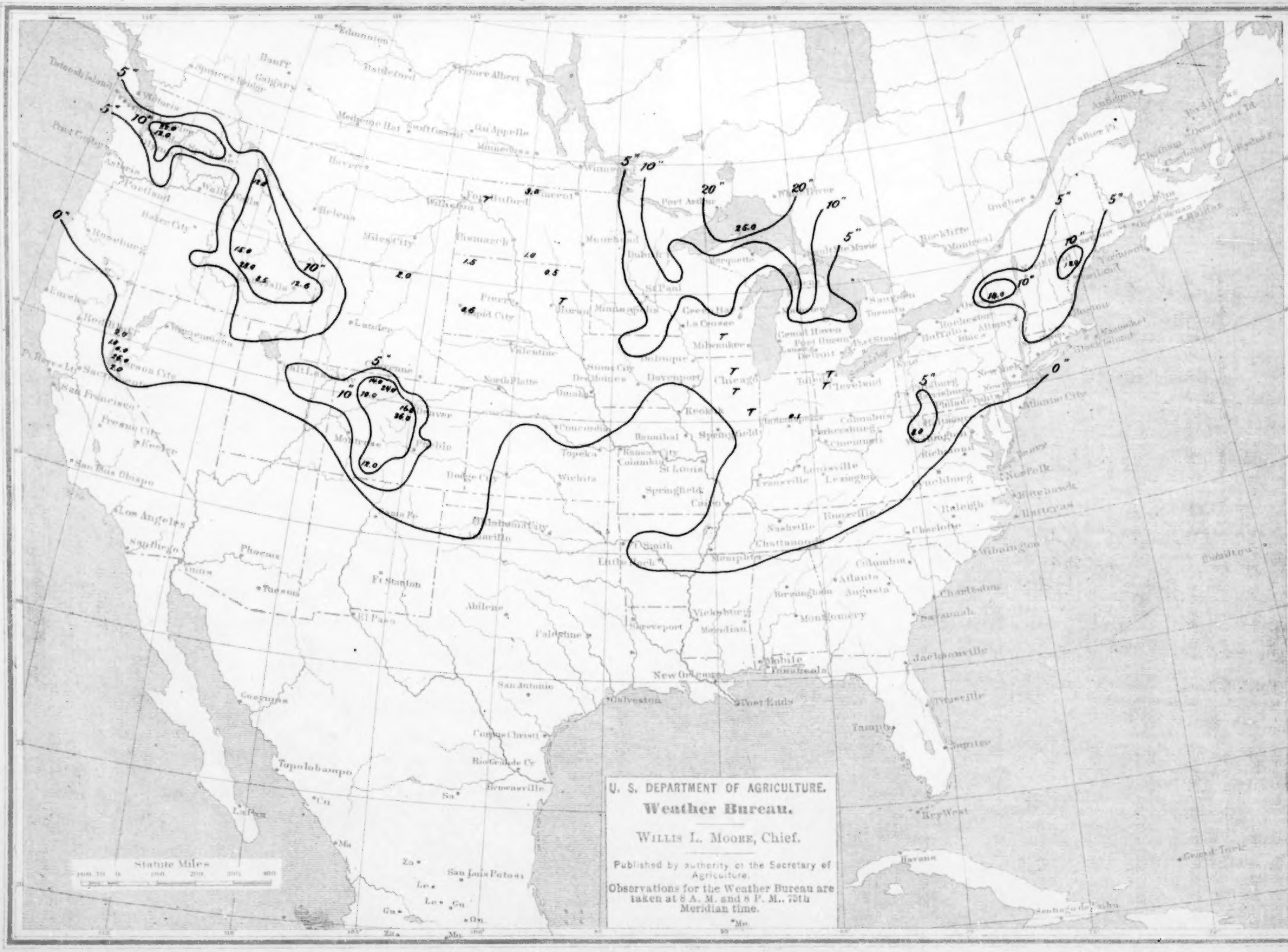


Chart X. Annual Frequency of Hail in the United States.

Chart XI. Thunderstorm Barograph Curves, September 17-18, 1895.

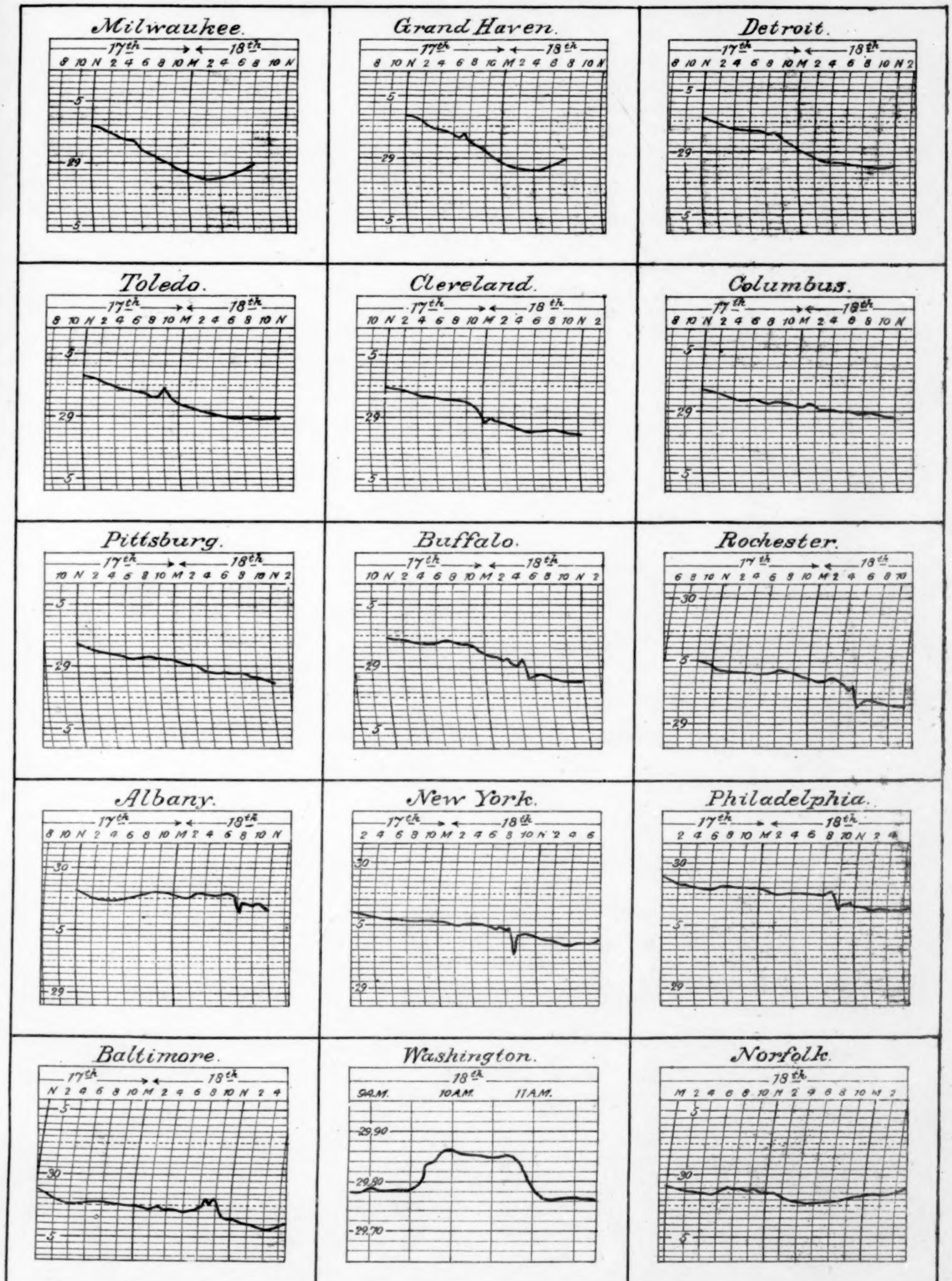


Chart XII a. Isobronts, September 17-18, 1895.

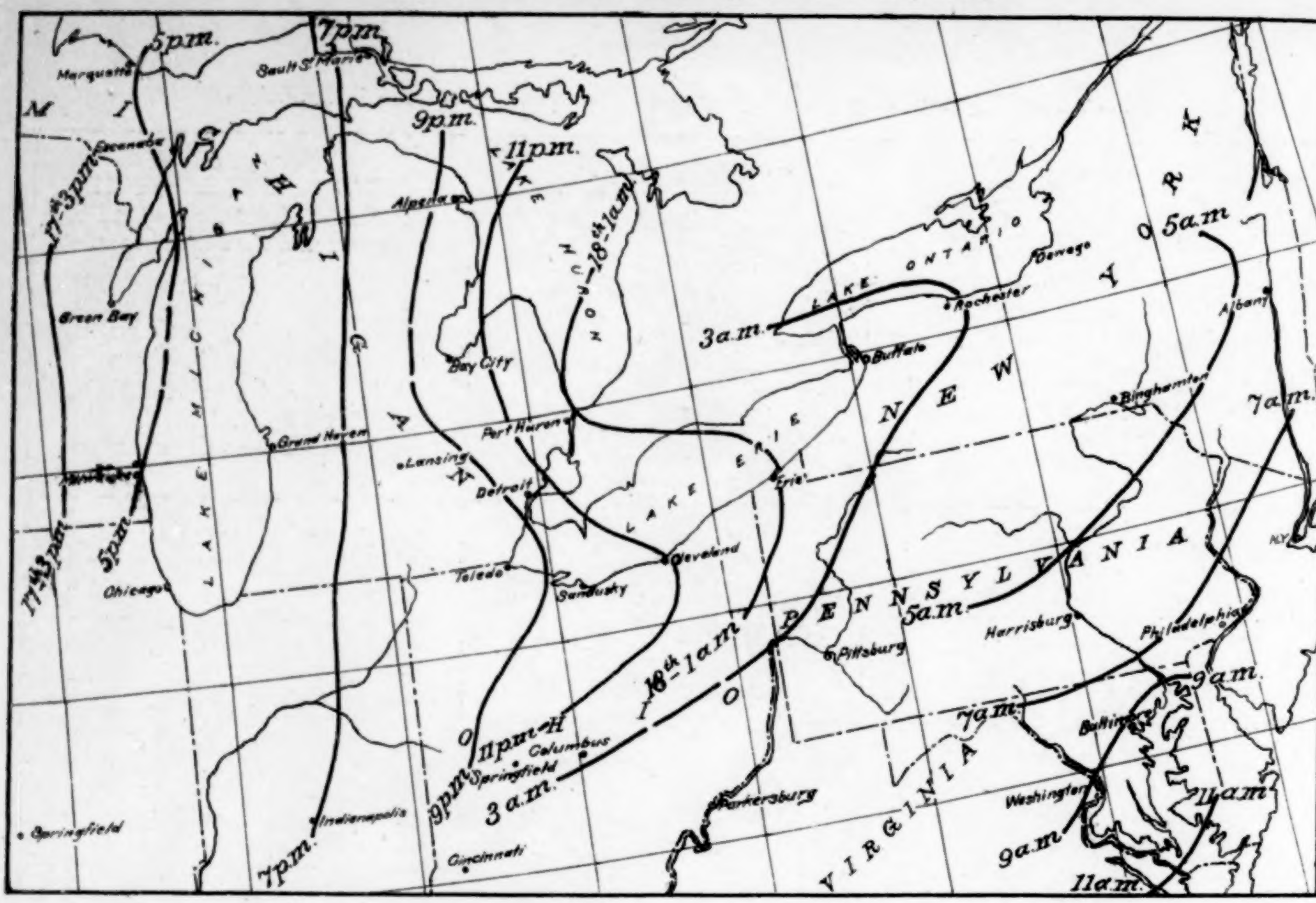


Chart XII b. Thunderstorm Barograph Curves, June 20-23, 1896.